ARI Contractor Report 97-28

Army Reserve Components Research Roadmap (Volume 2): Research Agenda

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DTIC QUALITY INSPECTED 3

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September 1997

United States Army Research Institute for the Behavioral and Social Sciences

U.S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES

A Field Operating Agency Under the Jurisdiction
of the Deputy Chief of Staff for Personnel

EDGAR M. JOHNSON
Director

NOTICES

REPORT DOCUMENTATION PAGE

1. REPORT DATE (dd-mm-yy) September 1997	2. REPORT TYPE Final	3. DATES COVERED (from. . . to) July 1996-August 1997
4. TITLE AND SUBTITLE Army Reserve Components Research Roadman (Volume 2): Research Agenda		5a. CONTRACT OR GRANT NUMBER MDA903-93-D-0032; DO# 0045 5b. PROGRAM ELEMENT NUMBER
6. AUTHOR(S) Deirdre J. Knapp, J. Patrick Ford, and R. Gene Hoffman		5c. PROJECT NUMBER D730 5d. TASK NUMBER 2001 5e. WORK UNIT NUMBER C01
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Human Resources Research Organization (HumRR0) 66 Canal Center Plaza, Suite 400 Alexandria, VA 22314		8. PERFORMING ORGANIZATION REPORT NUMBER FR-EADD-97-20
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Research Institute for the Behavioral and Social Sciences 5001 Eisenhower Avenue Alexandria, VA 22333-5600		10. MONITOR ACRONYM ARI 11. MONITOR REPORT NUMBER Contractor Report 97-28

12. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

This report is published to meet legal and contractual requirements and may not meet ARI's scientific and/or professional standards for publication

14. ABSTRACT *(Maximum 200 words)*:

There is increased awareness of the Reserve components (RC) and their role in our national defense. Downsizing and federal budgetary constraints continue to impact this role as well as the structure of the RC. In the past, most policy and practice considerations focused on the Active Component (AC). Research and experience, however, suggest that important differences exist between the tow components. Thus, the results of manpower, personnel, and training research conducted with the AC may not necessarily apply to the RC.

The goal of the present project is to highlight the results of research conducted for the RC by the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) and to generate an agenda for future ARI work that is responsive to current and projected RC needs. The work is documented in two separate volumes. Volume 1 (Ford, Schultz, Knapp, & Katz, 1997) provides a brief overview of the RC environment and includes summaries of ARI research products/findings currently available for RC use. This second volume discusses RC research in a number of domains (e.g., training-related areas, recruiting, retention, leadership). Critical research questions are identified and suggestions for using these as a basis for an ARI RC-related research agenda are offered.

15. SUBJECT TERMS

Reserve components Training Manpower Personnel

SECURITY CLASSIFICATION OF			19. LIMITATION OF ABSTRACT	20. NUMBER OF PAGES	21. RESPONSIBLE PERSON
16. REPORT Unclassified	17. ABSTRACT Unclassified	18. THIS PAGE Unclassified	Unlimited		Joseph D. Hagman 208-334-9390

HumRRO

FR-EADD-97-20

CONTRACT FOR MANPOWER AND PERSONNEL RESEARCH AND STUDIES (COMPRS) FOR THE U.S. ARMY RESEARCH INSTITUTE (ARI)

THE U.S. ARMY RESEARCH INSTITUTE'S RESERVE COMPONENT RESEARCH PROGRAM: PRODUCT REVIEW AND FUTURE DIRECTIONS

FINAL STUDY REPORT

ARMY RESERVE COMPONENTS RESEARCH ROADMAP (VOLUME 2): RESEARCH AGENDA

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Submitted to:

U.S. Army Research Institute for the Behavioral and Social Sciences
5001 Eisenhower Avenue
Alexandria, VA 22333

Contract Number MDA903-93-D-0032
Delivery Order 0045
CLIN No. 0002AB

August 20, 1997

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INTRODUCTION

The purpose of this project is twofold: (a) to provide in a single source document the results of selected research and development (R&D) efforts undertaken by the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) on behalf of the U.S. Army's Reserve Components (RC) (i.e., Army National Guard [ARNG] and U.S. Army Reserve [USAR]), and (b) to generate an agenda for future ARI work that is responsive to current and projected RC needs. Project results are documented in a two-volume report. The first volume describes the R&D results obtained in the areas of manpower, personnel, and training from the year 1980 to the present (Ford, Schultz, Knapp, & Katz, 1997).

The purpose of the research agenda described in this second volume is to provide ARI researchers and Army policy-makers with suggestions about how scarce research resources might be most effectively spent to support the needs of the RC. Critical research questions across a variety of manpower, personnel, and training domains are identified to help assure that they are not neglected in ARI research program planning activities.

Before turning to discussions of individual areas of research, the following sections (a) describe the study approach, (b) review the nature of the RC environment, (c) discuss ARI's research and consulting roles in support of the RC, and (d) describe the organization of the remainder of the report.

Study Approach

As mentioned, one purpose of this project was to identify and describe prior ARI research supporting the RC. The Volume 1 report (Ford et al., 1997) briefly describes the RC environment and how this environment differs from that of the Active Component (AC). The bulk of the report reviews training- manpower- and personnel-related findings/products developed by ARI since 1980. These "product summaries" cover why, how, and with whom the research was conducted; what was found/developed; what the implications are; and where more information can be found. The latter is provided in the form of specific product and related references placed at the end of each summary.

Development of a research agenda was the second major goal of this project. The agenda is based on the integration of input from a variety of sources, including interviews with policy-makers and researchers, ARI research literature, and articles and documents describing the RC environment and related research conducted outside ARI.

A critical component of this project was the set of interviews that were conducted to gather information and ideas from researchers and RC personnel. Interviews were conducted

from October 1996 through February 1997. While most interviews were conducted face-to-face, some were carried out via telephone.

A summary of the individuals who participated in the interviews is provided in Appendix A. Our goal was to interview researchers and RC personnel (both ARNG and USAR) representing a variety of perspectives, including those most familiar with training, manpower, or personnel issues and individuals at higher levels who are responsible for research and operations that span all of these areas. The focus of the interviews varied somewhat depending upon the interviewee. All participants were asked to describe trends affecting the RC that might affect the type of research that would be useful for addressing future needs. Researchers were asked to describe their research and ideas for future research; RC personnel were asked to indicate what types of research questions would be most relevant to them.

Information and ideas generated in the interviews have been incorporated into the content of this report. Indeed, the interviews were instrumental in determining both the structure and content of the following discussions of training, manpower, and personnel research provided herein. Unedited summaries of the interviews have been provided to ARI.

Relevant ARI research literature was located and reviewed as part of preparation of the project's Volume 1 report. Throughout the course of the project, we also collected articles and documents that described the current and projected structure and environments for the USAR and ARNG. These included, for example, posture statements, the Army Green Book, General Accounting Office (GAO) reports, and newspaper clippings.

To gather information about related research literature not sponsored by ARI, inquiries were made to the Defense Technical Information Center (DTIC) and researchers at several other institutions were interviewed. The intent was to be able to give a flavor of what other research may be available to ARI and the RC to help address critical RC-related research questions.

Despite initial attempts to quantify user and researcher priorities, at least at a fairly global level, it became increasingly clear that most interview participants were not comfortable recommending priorities that cut across different research domains. The problem was that most interviewees, both researchers and policy-makers, felt that they had perspectives that were limited to certain areas (e.g., training *or* recruiting). Therefore, we suspended plans to have them complete a follow-up prioritization survey. Such a survey was used successfully in the Joint Service classification research roadmap study (J.P. Campbell, Russell, & Knapp, 1994). The focus of that project, however, was on one general research domain. The focus of the present project is much broader. As a result, we attempted to identify which issues were viewed as worthy of further exploration and which were not, based on the qualitative input of our interviewees as well as our analysis of related information.

The RC Environment

The Volume 1 report (Ford et al., 1997) describes how the RC, both USAR and ARNG, are very different environments from the active Army. These differences create unique needs for the RC that cannot necessarily be addressed by R&D work for the active Army. These needs revolve around four themes.

First, duty time is severely limited for USAR and ARNG personnel. Most obviously, this limits the amount of training time available. Speed of training, in addition to the cost of training, is supremely important. Training designs and training effectiveness studies that do not consider training time are, therefore, not particularly useful for the RC environment. Furthermore, the importance of training time has an important implication for manpower and personnel. Personnel policies or programs that can reduce the need for training benefit the RC by helping it manage its time constraint problem.

The next two factors both relate to geographical dispersion. Neither units nor personnel are typically located in a confined geographic area like they are in the AC. Unit headquarters, training sites, and equipment storage locations tend to be widely dispersed. For example, companies within ARNG battalions, on the average, are spread over a 150-mile radius. This obviously makes training above the company level difficult for any time other than annual training (AT). In addition, company armories are often not co-located with their equipment. Thus, accessibility to equipment is limited. This problem is compounded by the fact that training areas may also be dispersed from equipment storage sites. These aspects of dispersion obviously affect training; they emphasize the need to consider where training is to be conducted. Travel time is not free, it is a debit on duty time. Therefore, the closer training opportunities are to unit headquarters, the more time units can spend productively training.

In addition to unit dispersion, individuals tend to be widely scattered as well. This is important because a considerable amount of RC work occurs during times other than weekend multiple unit training assemblies (MUTAs) and AT. Only limited amounts of funds are available to pay for individuals to participate in extra duty time either for training or for the planning and management of training. The soldiers themselves contribute additional time. Individual dispersion creates it own cost when these soldiers, often on their own time, must travel to meetings or training sessions. To the extent that this cost exceeds the capability or willingness for soldiers to engage in extra duty time, the RC becomes less programmatic in managing and delivering training. Policies, programs, and information transfer techniques that can increase the accessibility of individual soldiers to each other and to training resources are a particular benefit for the RC.

The final two factors also evolve from a single theme that plays out at the individual and unit levels. Turbulence, as described by the Volume 1 report (Ford et al., 1997), concerns both the rate at which RC soldiers turnover and the rate at which RC units change missions and structures.

Individual turbulence is a significant fact of life for RC units as new persons, often without prior service, are introduced to units, and as established persons move, change unit affiliations, and frequently change military occupational specialties and branches as well. Individual turbulence is essentially where the training and manpower/personnel domains intersect. Turbulence is moderated by manpower/personnel policies, with the remaining effects absorbed by training.

Similarly, at a higher level of decision-making, fluidity in the assignments of force structures to units creates wide spread change which affects whole units and not just proportions of individuals within units. For example, the ARNG is anticipating the structural changes that will cascade down from the newly released Quadrennial Defense Review (Department of Defense, 1997). While the new recommendations do support continuation of the previously initiated enhanced Separate Brigade (eSB) program for selected combat units, it also recommends the conversions of other combat units to combat support and combat service support functions.

Multiple Roles for ARI

The goal of the RC is to maintain soldiers and units at a sufficient state of readiness for them to be responsive to activation and mobilization. Individuals and units must attain and maintain the basic skill levels necessary for them complete their skill acquisition during mobilization training. The factors described above (time, unit and individual dispersion, unit and individual turbulence) create demands and boundaries for training and manpower that all point toward the same direction. Within the demands of force restructuring, manpower practices must reduce the negative impacts of turbulence and training practices must become as streamlined as possible.

Solutions to these manpower and training practices needs require a variety of actions. Needs must be clearly articulated, with both constraints and opportunities described. Potential solutions need to be designed, within realistic time frames and resources. Alternative solutions should then be evaluated, through trial implementation, modeling, or reasoned judgment. Solutions must be implemented and adjusted as needed. Finally, ongoing evaluations should continue to monitor the efficiency of the program or practice. These are all basic ongoing organizational problem-solving requirements.

ARI can and should be involved in each of these steps, even though not all of the steps constitute "research" in the traditional sense. In other words, ARI has a technical advisory role as well as a research mission. ARI researchers possess the expertise to provide valuable insights into training and personnel issues based on the accumulation of their experiences. When RC questions arise in these areas (e.g., selection of one particular instructional media design versus another), prudence may dictate that expert judgment is the most efficient decision tool. At other times, exploratory research may be the best course of action. The difference between the two circumstances and deciding whether to conduct research or provide expert advice depends on whether there exists a reasonable body of knowledge from which to base recommendations, the cost of doing the research, and the expected incremental value of the research over expert judgment.

The purpose of this report is to develop a research agenda. However, ARI advisory functions cannot be overlooked. ARI is a store house of a wide range of technical knowledge which may be brought to bear on the design and development of prototype training and manpower solutions. Often, that technical knowledge has implications for policy. For example, decisions concerning manpower strategies may be made without sufficient grounding in human nature, unless careful attention is given to a diversity of considerations concerning human abilities and needs. Thus to be most effective in influencing RC practices in training and manpower, ARI needs to continue to be engaged in policy consultation, technical consultation, prototype development, and research.

Organization of Report

The following sections, which comprise the bulk of this volume, discuss R&D work projected to be needed by the RC over the short and long term. This discussion is divided into the following research domains:

Training

- Training Aids, Devices, Simulators, and Simulations (TADDS)-Based Training
- Performance Measurement
- Training Management
- Distance Training

Manpower and Personnel

- Recruiting
- Retention
- Selection, Classification, and Performance Management
- Management Systems
- Leadership

The discussion of each research domain is intended to be a relatively brief, but informative, summary of the current state of knowledge as it relates to the Army RC. Many of these discussions refer to work that has been done outside ARI and outside the Army, but thorough reviews and analysis of such work were beyond the scope of this project. Each discussion ends with a list of critical research questions, with a short explanation of each requirement listed. Most of the suggestions are for applied R&D, extending themes and building programmatically from past efforts. This is particularly true for the training research domain. ARI has been more active in the training research domain for the RC and therefore the research agenda for that domain tends to elaborate technical nuisances related to ongoing projects more so than the manpower domain. To create a greater sense of comparability between discussions of the two domains, a special section is included in the discussion of the training research domain that suggests new research directions.

Following presentation of each of the research domains, an overall research agenda is provided. This serves as a summary and integration of research questions and issues that cut across the individual research domains. Finally, the report summary provides suggestions for ways in which the research agenda might be put to most effective use by ARI and its sponsors.

TRAINING RESEARCH DOMAINS

In 1985, ARI established a research unit in Boise, ID devoted specifically to the conduct of RC-specific R&D activities. Research conducted by that unit and others within ARI has shown that innovations in training are applicable to the RC environment. Using distance learning (DL) for individual qualification and simulations for collective tactical training are examples. It is also the case that the questions that were appropriate for earlier generations of TADSS continue to be appropriate for more advanced TADSS, including questions concerning cost-effective ways to implement TADSS in an RC environment. Thus at a general level, most of the research questions posed in the following discussions could have been asked years ago, and many of them were. Continued research along these lines, however, will help show how new technology improvements can increasingly make TADSS and other enhancements practical solutions to persistent training needs.

It should also be noted that the questions presented in the following sections focus on development as well as research. This is a reflection of Army needs. As technology has advanced, training resources have declined. One result has been a reduction in the training development staff of the U.S. Army Training and Doctrine Command (TRADOC). ARI has helped fill the gap by developing content for TADSS and other innovations in addition to evaluation the effectiveness of the applications. Interviews with ARNG officers strongly reinforced the idea that ARI should continue in that role.

TADSS-Based Training

The effective and efficient use of TADSS is vital for enabling RC units to achieve and sustain readiness because TADSS have the potential to overcome, at least partially, environmental constraints for the RC. Simulations, particularly low-cost part-task simulators, can provide soldiers with more ready access to training than training on operational equipment. As previously discussed, RC environmental constraints are such that even small gains in training efficiency can be significant. As a result, much of the research that guides acquisition of TADSS and implementation of TADSS-based training in the AC and RC has been conducted in the RC environment. Examples include prediction of live fire from COFT, simulation networking (SIMNET) for collective tactical training, and Janus for staff training. The RC's particular need for efficiency makes it a fertile ground for continued research on ways to develop and validate TADSS-based training. Research issues associated with this domain are presented in six sections: cost effectiveness trade-offs, part-task training, fidelity requirements, computer-generated forces (CGF), training support, and strategies.

Training Efficiency and Cost Effectiveness Trade-Offs

The fundamental assumption in procuring any TADSS is that using the TADSS will improve job performance. Conducting research to confirm such a positive relationship is challenging enough, but more complex questions about the monetary bottom line for training might also be asked (Hoffman & Morrison, 1992):

- What gains in proficiency accrue as a function of training costs?
- Do the transfer benefits of new TADSS justify their operational costs?
- To what extent can practice on the TADSS be substituted for practice on operational equipment or in a field environment?
- What is the optimal mix of training on TADSS and operational equipment/field training?

These questions require an examination of the relationships and trade-offs between training resources and performance proficiency to find the mix of training methods that either maximizes performance for a set training budget or minimizes cost for a given training standard.

Hoffman and Morrison (1992) described minimum and desirable design attributes for trade-off research. The first minimum requirement is that there should be variation in resources under investigation (e.g., trials on a training device). A desirable attribute is that the variation should be systematic, but since resources are under the control of training managers, natural variation is more likely. The second minimum requirement is that the criterion training method (e.g., live fire) should be repeated. Such repetition allows for "interface" effects--when differences between the response characteristics of TADSS and operational equipment result in a short-lived deficit in criterion performance--and provides cost information on the operational equipment/environment. The third minimum attribute is that other related training should either be held constant or measured (to be controlled during the analysis). For example, a trade-off study of an armor gunnery device and live-fire should at least document the extent of sub-caliber exercises.

Given the costs of conducting trade-off research, it is not surprising that such research in the Army (or anywhere else) is rare; Hoffman and Morrison (1992) reported only three examples, all in aviation prior to 1981. With the introduction of more sophisticated, higher-cost TADSS, the need to answer the cost-effectiveness questions will increase. Training of the Individual Ready Reserve (IRR) is an especially promising environment for trade-off research on TADSS, since multiple repetitions of training on the operational equipment are often planned as part of the train-up (e.g., repetitions to mastery for aviators) and there are few intervening conditions.

Alternative Training Effectiveness Questions

In addition to the resources and control required to conduct empirical trade-off studies, researchers working with RC training should consider whether the trade-off design is always appropriate for the RC environment. The trade-off design makes the most sense when trainers have a choice between training with a TADSS or training with operational equipment in the field.

RC trainers may have to choose between training a set of tasks with a TADSS or not training them at all. For example, during the formative evaluation of the Janus-mediated staff exercise (JMSE), staffs were asked to compare JMSE with a field command post exercise (CPX). One unit was unable to make the comparison because they had not conducted a field CPX for several years. Hoffman and Morrison (1992) expressed the primary RC issue as "how to pack more practice, by whatever training method, into the allotted time." Less demanding designs can give Army decision-makers information on the effectiveness of TADSS to defend their acquisition and encourage their use in training. Three alternatives research designs have been applied by ARI researchers in recent studies of RC training: transfer-of-training, performance improvement, and prediction.

Transfer-of-Training. The transfer design compares a group that receives training on the TADSS to a group with similar characteristics that receives either no training or perhaps an alternate method of training. For example, ARI researchers used this design to assess the transfer of training from the Model Training Program-Reserve Component (MTP-RC) maintenance training system to troubleshooting on the operational M1 tank (Graham, Shlechter, & Goldberg, 1986). They found that recent graduates of advanced individual training improved during repeated trials on the MTP-RC computer-based instruction and performed significantly better on hands-on tests on the operational tank. Boldovici (1987) has provided ARI with a comprehensive treatment of the methodological strengths and implementation pitfalls for transfer-of-training research. These types of studies are particularly strong for determining whether training has occurred. They do not, however, provide information about training efficiency unless cost information is included in the interpretation of the results.

Performance Improvement. A simpler, but less powerful, alternate approach is to document whether soldiers learn on the TADSS. Formative evaluations of TADSS for individual training often include pretests and posttests of material covered by the TADSS (e.g., Andre' & Salter, 1995; Deterline & Keesling, 1995; Keesling, 1995). Researchers can also document learning for TADSS for collective training, such as the assessment of SIMNET for platoon and company missions (Shlechter, Bessemer, Nessleroade, & Anthony, 1995). In that assessment, ARI collected task ratings by leaders before and after training, structured Observer/Controller (O/C) feedback so that improvement could be monitored, and measures of efficiency (e.g., time to complete mission). While this design approach can be criticized for its unsophisticated research methodology, it has merit when alternative control and experimental training groups cannot be established, when researchers cannot be given control over training schedules, and when training does not vary among soldiers. It at least provides some indication of learning, and Kraiger et al. (1997) have suggested that appropriately worded questions about learning may be used as signals for potential usefulness of training.

Prediction. Another way to estimate whether a TADSS may be a potential as a substitute for training on operational equipment is to demonstrate the predictive power of the TADSS. Work with armor gunnery (Hagman & Smith, 1996) and rifle marksmanship (Hagman, in press) illustrates that approach. In those cases, crews or individuals fired exercises on a simulator and fired for record on live-fire ranges. The simulators were the COFT for armor gunnery and the

Engagement Skills Trainer (EST) for rifle marksmanship. There was no training between the TADSS and live-fire measures. ARI researchers found that the relationships between performance on the simulator and live-fire scores were strong enough that trainers could predict live-fire performance from performance on the simulators. Results from studies of prediction inform decisions about substituting simulator exercises for live-fire and help trainers focus resources on individuals or crews who need more training to reach qualification levels.

Strictly speaking, this design only shows a correlation between the device and the operational equipment. However, the approach has merit on three grounds. First, if a prediction fails to show a correlation between the device and performance in the operational setting, than the utility of the device for training is called into question. The design is potentially an inexpensive way rule out unsound training devices. Second, if a prediction study shows such a correlation, and a performance improvement study can show that varying amounts of practice on the device can improve device performance, then the combination of results suggests that the device may have training value. Third, even correlational evidence supports training management decisions. For example, Hagman and Smith (1996) illustrated that COFT may be used to identify tank crews who have a high probability of failing to qualify on tank gunnery Table VIII.

Research Questions

The preceding discussion suggests two research questions that should routinely be asked when fielding a new or improved TADSS. These relate to its effectiveness and the cost savings it will yield. While these are applied research questions, we also suggest that ARI pursue more basic research that examines whether there are types of skills that are more or less effectively trained through the use of TADSS.

How effective is a given TADSS in the RC environment? At a minimum, researchers should establish whether reservists acquire relevant skills using the TADSS and that the TADSS is compatible with RC training schedules. If the research compares soldiers or units, researchers should document characteristics of the soldiers and units being trained and intervening training events. The sample should be controlled to assure adequate variance for projected analyses and protect against systematic differences in experience or aptitude.

What savings associated with TADSS-based training should be expected? Even if an empirical trade-off study is not practical, decision-makers need cost data to determine whether to procure the TADSS for implementation in RC training. If a TADSS is found to be effective, researchers should identify where savings from implementing the TADSS would be reflected. For example, Hagman and Smith (1996) calculated ammunition savings associated with increases in first-run crew qualification. Similar information could be developed for costs of non-gunnery collective training conducted in the field, such as a platoon level field training exercise (FTX), to include numbers of personnel, numbers of vehicles and radios, miles on vehicles, hours of use of simulators, and dollars for other costs. Documenting costs of field training will require focused data collection, since standard record keeping systems vary from installation to installation (Ashworth, Phelps, Graham, & Wisher, 1992) and are maintained with

varying degrees of accuracy and timeliness (Keenan, Keesling, & Graney, 1996). Further, units do not typically record resource expenditures on an event-by-event basis.

Can performance categories be identified for which alternative TADSS designs are most effective? The research cited above included training for both cognitive and physical skills. In some simulations, the simulator is the soldiers' environment (e.g., COFT). In other simulations, such as for the battalion staff in a SIMNET exercise, the simulator is removed from the staff members as they interact with soldiers who are physically encased in the simulation. The crew members in COFT are learning precise motor skills and tightly coordinated (though fairly simple) team skills. These skills can and should become highly automated. On the other hand, the battalion staff members are learning a much less routinized, more adaptive kind of activity. While both tank crew and battalion staffs are learning to react quickly to environmental cues, the two differ widely in the complexity of environmental cues and the speed of needed reactions. Staff members are concerned with patterns of locations for several dozen vehicles; tank crews deal in precise location of a few vehicle. Staff member reactions are in minutes; tank crews are in tenths of seconds. The learning task is quite different. Kraiger et al. (1997) argue that training research designs should become more attuned to those differences. They have suggested an elaboration of Kirkpatrick's (1976) time honored four levels of research criteria. ARI could continue this line of thinking by more explicitly specifying the criteria appropriate for the different types and complexity of the skills being acquired and the research methodologies needed to support sound training decisions. For example, learning in the training environment, if appropriately measured, may be an adequate index of training effectiveness for complex cognitive skills. ARI could provide much needed leadership is this basic research area.

Part-Task Training

Research on part-task training addresses the question: Are there ways in which a complex task can be broken down into parts that can be learned more efficiently than the whole task itself? Part-task training using TADSS has been an especially promising approach for flight training and has been studied in relation to armor gunnery. The approach enables repeated practice on critical skills that do not occur frequently in a whole-task context (e.g., emergency procedures), allows trainers to focus on tasks where the operator attends to other activities, supports the training of new response requirements for new equipment or missions, and helps with sustainment of easily forgotten responses (e.g., procedures). In addition, part-task trainers tend to be less expensive and therefore may be distributed more widely than other types of training simulators. The advantages to the RC, with its geographic dispersion of troops and equipment, are obvious.

Requirements

A part-task training procedure should specify a method for partitioning the task for training and a method for reintegrating the task as training progresses. Three categories of partitioning methods have been identified (Naylor, 1962): simplification (changing characteristics, such as time requirements, to make a task easier); fractionation (dividing the task

into separate time-shared dimensions, such as procedural then perceptual requirements); and segmentation (dividing the task on temporal or spatial dimensions). Partitioning recommendations in Army tactical training tend to favor simplification (e.g., crawl-walk-run). For example, training developed for ARNG battalion level battle staffs enables a sequence that focuses first on information processing with a few officers (C/ST Staff, 1995), proceeds to staff integration with a full staff (Hoffman, Graves, Koger, Flynn, & Sever, 1995), and culminates with staff operations in a simulation of a battalion-level execution of a tactical mission (C.H. Campbell, R.C. Campbell, Sanders, Flynn, & Myers, 1995). The segmentation strategy was used to divide training for the brigade staff decision-making process into a series of training vignettes which isolate attention to specific portions of the process (Graves, J. Campbell, & Deter, in preparation).

Three methods have also been identified for reintegrating the task (Naylor, 1962): pure (separate practice on each part before transfer to the whole task--A, B, C, ABC); progressive (A, B, AB, C, ABC); and repetitive (A, AB, ABC). A frequently recommended variation is a reverse repetitive schedule (C, BC, ABC), sometimes called a backward-chain schedule. Wightman and Lintern (1984) recommended segmentation for partitioning and backward chaining for reintegrating. Work by Bailey, Hughes, and Jones (1980) illustrates the recommended part-task procedure. They partitioned a dive bomb task into base leg, roll-in, and final approach segments. For integration, subjects first practiced the final approach, then practiced roll-in and final approach, and finally, practiced base leg, roll-in, and final approach. Subjects trained by the part-task approach showed more accuracy and higher rates of achievement of the criterion within the time allotted than subjects trained by a whole-task method.

Benefits

While the aviation psychology literature indicates that part-task training is effective, especially for the segmentation/backward chaining technique (Knerr, Morrison, Mumaw, Stein, Sticha, Hoffman, Buede, & Holding, 1986), findings have not universally endorsed it. For example, Adams' (1960) review of early research found that the evidence favored whole-task training 2:1. Still, there has been an increasing interest in part-task training. Two reasons for this increasing interest are especially pertinent for research on part-task training in the RC environment: applicability to transition and sustainment training, and cost/time savings (Knerr et al., 1986).

The potential for part-task TADSS is clearest for transition and sustainment training (as opposed to initial training). The proliferation of operational equipment (e.g., aircraft) and the need to sustain skills through long periods of peacetime make the application of part-task TADSS especially relevant for RC training. Effectiveness for transition and sustainment varies as a function of task organization, complexity, and trainee ability. Unorganized, more complex tasks and low trainee ability favor part-task approaches (Wells & Hagman, 1989).

The second proposed reason for research on part-task TADSS in the RC is that part-task training is potentially less expensive than whole-task training. Even without considering the cost of the TADSS, time scores in early research tended to favor part-task training. Even Adams

(1984) concluded that "a combination of part- and whole-task training may be more cost effective than whole-task training alone" (p. 64).

Development Approaches

Achieving those potential savings requires research into ways to combine part-task TADSS training, whole-task TADSS training, and operational equipment training in an RC environment. Cognitive task analysis techniques help identify skills to be addressed and empirical approaches can help refine the part-task strategy.

Cognitive Task Analysis. Cognitive task analysis techniques are useful for identifying skills that can be trained with a part-task approach. For example, Schneider's (1985) analysis of a subtask of air intercept control identified eight skills that could be trained independently and integrated into superordinate subtask or task performance. Fisk and his colleagues (Eggemeier, Fisk, Robbins, & Lawless, 1988; Fisk & Eggemeier, 1988) have developed a less resource intensive front-end analysis methodology that has been used to identify cognitive, perceptual, and motor skills required for aircraft command and control tasks.

Empirical Information. As an example of an empirical approach to decide how to combine TADSS, Hart, Hagman, and Bowne (1990) measured the effects of transfer from a part-task trainer (TopGun) to a whole-task simulator (COFT) and found the transfer to be rapid (one 20-min block significantly improved COFT accuracy).

Research Questions

In concept, the applicability of part-task training for the RC is clear. The critical research questions are specific to each training requirement that part-task training might be used to address.

How should a task be segmented for part-task training? A part-task training strategy assumes that the part is important and training with a TADSS that represents it will produce positive transfer. A substantial body of research indicates that the validity of the assumption depends on the characteristics of the task and how the task is segmented (Knerr et al., 1986). Cognitive task and hierarchical analysis approaches help partition the task into meaningful components. Candidate cognitive analysis approaches are task structure analysis and task process analysis. A task structure analysis describes how knowledge is organized among the people to be trained (Morrison, 1984). Task process analysis describes how the activities that make up a task are organized. The results of such an analysis are expressed in condition-action rules (e.g., if the machine gun bolt is forward and the safety is on fire, pull the bolt back). Research should develop guidance on which approaches are appropriate for various task types (procedural, perceptual, perceptual-motor, and decisional) and proceduralize the techniques.

What is the optimum mix of part- and whole-task devices? Work on identifying prerequisite skills levels (often called "gates") for whole-task TADSS (e.g., reticle aim levels to change levels within COFT and indicate readiness for live-fire) should be extended to part-task

TADSS to indicate when training would be more efficient on a whole-task TADSS. Experimental designs should control for trainee experience and ability level and the criteria of effectiveness of candidate combinations should include time-to-criterion and retention.

TADSS Fidelity Requirements

Research on TADSS fidelity addresses the question: What level of fidelity is required for a TADSS to provide the physical events and conditions that are necessary to support training? (Hughes, 1979). The goal is to provide procedures to determine what the phrase "necessary to support training" means. The question is important for RC training because of the impact that development costs have on the number of TADSS that can be distributed to RC units. Like the part-task trainer, low-fidelity trainers tend to be relatively inexpensive and thus can be fairly widely distributed on a fixed budget.

The proposed research considers two dimensions of fidelity and applies a range of metrics to those attributes. The range of attributes associated with each dimension and the fidelity metrics are shown in Table 1, which is adapted from guidance for the development of models of aviation simulators (Sticha, Blacksten, Knerr, Morrison, & Cross, 1986).

Scope of Fidelity

Table 1 identifies two categories of design attributes for TADDS, realism and comprehensiveness. Eight more specific attributes are listed within the two categories, with examples of each provided. Table 1 also proposes five criteria to inform decisions about whether a TADSS will yield adequate fidelity. Training transfer is the "primary" criterion, with the other four being "secondary." Obviously, the primary criterion of transfer can only be assessed after an operational prototype device is built. The secondary criteria, on the other hand, can be assessed during TADSS design. These secondary metrics are especially important given the trend toward an industrial model of acquisition (COL R. Krug, personal communication, December 12, 1996). The industrial model maximizes cost-benefit ratios with short development cycles and a quick reaction decision-making environment ("fire-aim-fire-aim"). The secondary metrics promise significant value for providing early evidence of whether training devices are effective.

Physical measures. Early research on TADSS found that training transfer from a photographic mock-up of a cockpit was comparable to training on a high-fidelity simulator (Prophet & Boyd, 1970). In the early 1980s, the Defense Science Board called for greater emphasis on low-cost TADSS, based in part on the premise that effective training can be accomplished with TADSS whose physical attributes differ substantially from the attributes of the operational equipment. There are, of course, limits to how far physical similarity can be degraded. But it is likely that dynamic response and sensory stimuli can exhibit lower fidelity than operational equipment in a field environment and still be effective. Research to identify appropriate levels requires measures of parameters that can be manipulated to vary realism or

Table 1.

Characterization of TADSS Fidelity

		Primary Criterion	Secondary Criteria			
TADSS Design Attributes		Training Transfer	Physical Measures	Ratings	In-TADSS Response	Analytic Measures
Realism						
Static Display and Control	• Dimensions • Control Layout • Control Design	X	X	X	X	
Dynamic Response	• Controls and Instruments • Motion Systems • External Display • Audio • Environmental Effects	X	X	X	X	X
Sensory Stimuli	• Visual • Auditory • Proprioceptive • Kinesthetic	X	X	X	X	
Comprehensiveness						
Static Display and Control	• Instruments and Controls	X				X
Dynamic Response Range	• Performance Envelope • Motion Systems • Instrument Readings • Control Input/Feedback • External Displays	X	X	X	X	X
Operational Tasks	• Individual • Crew • Team • Combined Arms	X				X
Operational Conditions	• Equipment Malfunctions • Degraded Visibility • Adverse Weather • Physical/Other Stress • Varied Topography • Varied Targets/Threat	X	X	X	X	X
Sensory Stimuli	• Visual • Auditory • Proprioceptive • Kinesthetic	X	X	X	X	

comprehensiveness. For example, a computer-generated scene might be quantified at various levels of elements (e.g., lines, polygons).

Ratings. Operational and developmental TADSS are frequently rated by subject matter experts (SMEs), for example, aviator ratings of the training value of operational rotary-wing simulators (McAnulty, Cross, & DeRoush, 1989). It has been observed that soldiers tend to be critical of low fidelity simulations (J. Hagman, personal communication, July 23, 1997). They typically do, however, perceive them to be sufficiently similar to the operational equipment. As a result, the applicability of ratings depends largely on methodological concerns, especially narrowing the focus of raters and training them to offset biases. Ratings are most promising when raters focus on specific attributes, especially the realism of dynamic responses. Research should assess training methods for SMEs (e.g., on sensation and perception) and develop scales that minimize rating errors (e.g., halo effects) for attribute ratings.

In-TADSS response measures. This metric compares an operator's response in a TADSS with responses in operational equipment under comparable circumstances or established performance standards. Sample metrics include peak performance level in TADSS compared with operational equipment or performance standards; type, frequency, and consequences of cognitive and motor errors; accuracy of absolute judgments (e.g., altitude); workload level; and patterns of eye movements (Sticha et al., 1986). The concept is an analog to physical similarity: if training can be effective despite departures from physical realism, can training also be effective despite differences in TADSS responses compared with operational equipment responses? Response measures are promising objective approaches to quantifying realism and comprehensiveness. Research implementing in-TADSS response measures should include collection of data on corresponding responses in the operational equipment.

Analytic measures. This class includes fidelity metrics, other than physical measures, that quantify the dynamic response and comprehensiveness of TADSS. In their simplest form, the measures consist of lists showing the range of tasks and conditions that can be trained in the TADSS. The approach has been valuable for estimating the degree that TADSS could support tank gunnery conditions (Hoffman & Morrison, 1988) and gunnery skills and knowledges (Campshure, 1991). A similar approach has been applied to collective tactical training (Burnside, 1990). These applications are based on a series of yes/no judgments concerning whether a condition or task characteristic is supported. In some cases, it may be desirable to add judgments of the level of realism. Research is needed to determine the accuracy of the early judgments and to extend the technique to attributes such as dynamic response and sensory stimuli.

A variety of models were developed during the late 1980s that combine data about the training environment, including TADSS fidelity, to predict transfer to the operational environment. The models consider information such as SME estimates about training requirements, task characteristics, trainee population skills, TADSS instructional features, and TADSS fidelity dimensions (Sticha, Blacksten, Buede, Singer, Gilligan, Mumaw, & Morrison, 1990). Five of the most promising models are:

- OSBATS (optimization of simulation-based training systems), developed for the Army oriented primarily on aviation (Sticha et al., 1990).
- FORTE (forecasting training effectiveness), developed for Navy aviation TADSS (Pfeiffer, Evans, & Ford, 1985).
- TECIT (training effectiveness and cost iterative technique), developed for Army TADSS (Goldberg, 1988).
- ASTAR (automated simulator test and assessment routine), developed to be incorporated into the Department of Defense (DoD) instructional system development process (Companion, 1990).
- VALTRAIN (value of training), which builds in part on OSBATS and TECIT (Witmer, 1991).

Efforts to refine and apply such models have been largely dormant since 1991, in part because of difficulties in convincing military decision makers that analytic methods (e.g., the secondary metrics) produce valid results (Simpson, 1995). The comments cited earlier about the need for information to support quick decisions early in the procurement of TADSS suggest that, ARNG decision makers, at least, recognize the promise of these methods to consolidate useful data in situations that preclude experimental methods.

Research Questions

The research questions related to TADSS fidelity are intended to revive research on transfer prediction models. The scope of that research includes selecting a model, improving data to be considered, and verifying the accuracy of predictions.

How should secondary fidelity criteria be combined to predict transfer? Initial efforts should provide information to support selection of one of the models for individual training. Subsequent research should improve the ease of applying the model and provide case studies that can guide extensions to other TADSS. Ultimately, research should be conducted to assess the applicability of the refined model to TADSS that involve collective tasks.

What measures should be applied for each fidelity attribute? Answering this question entails compiling a complete inventory of measures needed to quantify attributes of realism and comprehensiveness for a given TADSS. Inventories of measures based on operational TADSS would be valuable for guiding analysis of TADSS in development.

What methods should be applied to improve the quality of secondary fidelity criteria? Avenues of research on individual metrics were presented in the discussion of each criterion. Important topics include development of quantifiable physical measures, assessment of the impact of rater training on the reliability of ratings by SMEs, collection of data on operational equipment responses, and development of analytic approaches for dynamic response and sensory stimuli.

How do soldiers' reactions to low fidelity TADSS impact on the true importance of fidelity? The negative reactions that soldiers tend to have toward low-fidelity TADSS raises an interesting line of questioning. To what extent do soldiers attitudes about the TADSS they are training with influence their learning? Can these reported negative attitudes have an adverse effect on training and, if so, do fidelity criteria need to include consideration of these attitudes?

How accurate are predictions by a transfer prediction model? Validation data serve two purposes. First, they enhance the acceptability of the model by the Army leadership. Second, validation data help in refining the model, especially simplifying data collection and interpretation of results. If possible, a series of transfer studies as described in the section on cost trade-offs should be conducted. These studies should reflect systematic variation in fidelity levels of attributes that differ measurably from the corresponding attribute in the operational equipment. The research methods should incorporate a validated instructional system (sequence, tasks, and training support materials) and control for soldier experience. For RC purposes, it would be desirable for the experience level to be consistent with transfer or continuation training. Training effectiveness studies for the close contact technical trainer (CCTT) and lower-fidelity SIMNET would provide a unique opportunity to study a range of fidelity levels without having to reengineer a TADSS to vary attributes.

As a practical matter, training transfer studies may not be feasible because of resource constraints given the complexity of the models (which may result in more variations than there are subjects, especially for collective TADSS). In that case, empirical data should focus on submodels. For example, a validation of the OSBATS might focus on predictions from the Fidelity Optimization Module.

Training Support for TADSS

Work with the Reserve Component Virtual Training Program (RCVTP), which has been renamed the Virtual Training Program (VTP), illustrates one way that research organizations add value to Army training developments. ARI combined the efforts of behavioral scientists, experts in a subject matter area (e.g., battalion-level tactical operations), and experts in applying a given TADSS (e.g., SIMNET) to develop instructional content for a TADSS and develop training support packages (TSPs) to implement that instruction.

Development of TADSS-Based Instruction

If a TADSS is to be effective, it must be supported by systematic training procedures. Development of those procedures includes extending the content for existing TADSS applications and developing content for new TADSS applications.

Extend TADSS instruction. Implementing TADSS has resulted in a wide range of instructional content that has been shown to be practical for delivery in an RC environment. As more formal data on effectiveness accumulate, it will be desirable to develop additional instruction for the various TADSS. One type of extension is to convert instruction developed for one TADSS to a different, similar TADSS. The primary example of such a conversion is the development of

scenarios for CCTT based on SIMNET materials (COL R. Krug, personal communication, December 12, 1996). A second type of extension is development of similar materials for similar audiences. For example, the computer-based instruction (CBI) developed specifically for the ARNG battle staff in a heavy battalion task force is being extended to the AC brigade commander and staff. The AC materials might need to be converted for RC use and further materials might be developed for the staffs in other types of RC battalions. A third type of extension involves development of additional modules for current TADSS applications. For example, additional offensive and defensive missions are being developed for the Staff Group Trainer (SGT), and should be developed for multi-media interactive technology in the Armor Junior Leader Tactical Training Program (D.R. Jones, Bullock, Henriksen, & Tkacz, 1991).

Add TADSS instruction. Interviews with RC officers identified two potential applications of CBI. One officer requested the development of a structure that would enable units to develop CBI on immediate needs (COL D. Youngman, personal communication, December 12, 1996). The specific application was CBI to implement revisions to the standing operating procedures. An Adjutant General (TAG) requested a CBI program to assist junior officers in the transition from a basic course or AC assignment to an RC assignment. The instruction would prepare the officer to deal with challenges unique to the RC environment (MG Kane, personal communication, February 7, 1997).

Development of TSPs

A TSP integrates training products, materials, and information necessary to train one or more tasks. For TADSS applications, a TSP should include a training strategy, task list, learning objectives, an after action review (AAR) framework (including measures of performance), guidance to system operators, and guidance to O/Cs. The importance of such materials was underscored in one of our project interviews: "In Navy terms, a TADSS [in this case a Janus suite] without a TSP is a very expensive anchor" (COL R. Krug, personal communication, December 12, 1996). The research implication is that development and evaluation of TSPs should have a high priority in projects to apply TADSS. To accommodate RC time constraints, TSPs should be detailed enough to support a turn-key implementation that minimizes set-up requirements for RC trainers. The tryout of JMSE materials in a MUTA environment (Hoffman et al., 1995) illustrates the recommended approach to evaluate the full TADSS system.

Research Questions

As a practical matter, the effectiveness of a TADSS cannot be assessed unless the content is relevant to units' perceived needs and the delivery is efficient. Thus the questions discussed below are directed toward assuring that relevance and efficiency.

What content should be developed for TADSS training? Immediate candidates for extending applications include conversion for similar TADSS, applications for similar training audiences, and adding modules to existing TADSS programs. Candidates for new applications include a structure for locally produced CBI and a CBI program to facilitate the transition of junior officers to the RC environment.

How well do TSPs support implementation of TADSS training in the RC environment? At a minimum, TSPs should be subjected to a formative evaluation process (including revision) before a TADSS application is implemented.

Computer-Generated Forces (CGF)

Virtual tactical engagement simulation (TES) technology (e.g., SIMNET) allows collective training in manned simulators projected onto a common synthetic battlefield generated by computer. While the activities of the soldiers being trained determine the events, they operate in a context that includes adjacent units and an opposing force (OPFOR). Virtual TES can incorporate role-players for other forces (e.g., the "World-Class OPFOR" in the Battle Command Training Program). But using role-players increases support requirements and reduces flexibility, since a unit conducting the training must either supply role players from its resources or coordinate with another unit or agency to get the role players. For training economy, especially in the RC environment, it is desirable for these forces to be computer-generated. The research need is to develop a methodology to provide for CGF that act and react realistically on the simulated battlefield, while maintaining the same concern for fidelity requirements described in the previous section. Research on CGF should be directed toward procedures to identify CGF requirements and to develop cost-effective enhancements to realism in information processing and representation.

CGF Requirements

Friendly CGF include adjacent forces (e.g., flanking, screening, supporting, or supported units), higher headquarters (e.g., battalion and brigade for a company exercise), and subordinates (e.g., squad members for military operations in urbanized terrain). These forces should operate in a doctrinally appropriate way given the mission, enemy, terrain, friendly troops, and time (METT-T) conditions. Performance requirements for friendly CGF are well established for most combined arms units. The Blueprint of the Battlefield (U.S. Army, TRADOC, 1992a) presents a hierarchical structure of functions (i.e., battlefield operating systems) and subfunctions, and Army training and evaluation program mission training plans (ARTEP-MTPs) describe tasks required by functions. Detailed analyses of task requirements tied to functions have been developed in analyses of battlefield functions for the heavy task force (Mullen, 1996) and of command and control for the armored brigade and supporting battalions (Ford, Mullen, & Keesling, 1997).

Identification of OPFOR performance requirements is more of a problem. Since the well-defined doctrine for Warsaw Pact units may not apply, METT-T requirements will rely more on assumptions, projection, and partial intelligence than in the past. If there is to be a "doctrinal" OPFOR, even controllers of the OPFOR need to be constrained from gamesmanship that enable them to win rather than replicate OPFOR practices. Given the uncertainties associated with defining a doctrinal OPFOR, reassessing the benefits of a standardized OPFOR may be justified. The alternative--force-on-force exercises--may facilitate training more units in the RC environment.

Once performance requirements are identified, performance parameter values should be assigned for subordinate, adjacent, and OPFOR elements. Examples of parameter values are movement rates for dismounted infantry, number of rounds for fighting vehicles, defensive frontages for units, and kill probabilities. Values might be expressed as discrete values, ranges, or rules (for non-numerical characteristics).

CGF Enhancements

For CGF to be effective, capabilities must be enhanced in two areas: information processing and representation of dismounted elements. CGF are currently limited to avoiding fixed obstacles and choosing among predefined alternatives. Developments to enhance information processing should include improved terrain reasoning, movement control, situation assessment, tactics, and cooperation (Reece, 1994).

As simulations such as CCTT incorporate dismounted soldiers (e.g., infantry, engineer), the cost of representing the dismounts will become a major factor. For example, a combat vehicle can be represented realistically with 200 to 300 polygons. Similar realism for one human figure requires 1600 polygons (Sticha, R.C. Campbell, & Schwalm, 1996). The costs of realistic representation will certainly decrease, for example through innovations in JACK, the 3-dimensional human figure model used in computer-aided design. The RC concern is to be sure that the added realism (which restricts distribution of TADSS) is justified in terms of motivation and training transfer.

Research Questions

Are computer-generated OPFOR justified? One of the assumptions for CGF is that tactical training requires a doctrinal OPFOR. With the proliferation of potential scenarios, that assumption may not apply (COL Gordon, personal communication, February 7, 1997). The question is important for RC training because force-on-force exercises where both sides apply U.S. doctrine would increase the number of units who could be trained in a given time (e.g., one platoon defending against one or two attacking platoons).

How should requirements and parameters for CGF be established? Establishment of requirements and parameters involves interaction between training developers and SMEs. The focus of research should develop a methodology for identification of requirements and proceduralize the assignment of parameter values.

How are performance and training effectiveness affected by simplifications in the representation of CGF? This question is similar to questions on realism for a TADSS. In this case, research would systematically vary levels of CGF realism and document the effect on the cost and transfer effectiveness of the TADSS. Although development of CGF is not anticipated to be an ARI activity, the findings should be suitable for guiding refinement of current TADSS and developing emerging TADSS.

Micro-Level Strategies for TADSS

Macro-level strategies (discussed under Training Management) provide overall goals for training development and planning. For those goals to be achieved, each TADSS must be addressed by a micro-level strategy for training execution. Components of such a strategy include identification and organization of training objectives, assignment of TADSS to objectives, allocation of training times to objective/device combinations, the specification of the content of TADSS training, and the overall management of TADSS training (Morrison, Campshure, & Doyle, 1991). The overall management component of the strategy extends the gates concept from the macro-level strategy to determine when an individual or unit has reached a level of proficiency to justify moving to a different TADSS, field training, or a higher echelon. The COFT-based gunnery training strategy (Hagman & Smith, 1996) illustrates how a detailed micro-level strategy incorporating a specific TADSS can reduce training time.

Development and validation of each micro-level strategy offers an opportunity to assess the effects of learning variables on skill acquisition, retention, and transfer. While the emphasis is on maximizing the effectiveness and efficiency of a TADSS, researchers should document the impact of various approaches related to the conduct of AARs, timing and distribution of feedback, and implementation of methods to enhance retention.

AAR. The AAR is the primary form of performance feedback for tactical and battle staff training. Micro-level strategies for the RC should identify techniques that blend effectiveness and efficiency. One recommendation for enhancing the quality of the feedback is to compare staff and unit responses to expert responses, sometimes termed "A Way" (Brown, 1994). The impact of such an approach, while promising, has not been demonstrated. Expert comparisons might well be compared to improvement-based feedback, which has been well received by ARNG units in the VTP (Hoffman et al., 1995). Another distinction in AAR techniques concerns directed versus discovery learning. In the recommended discovery technique, O/Cs lead discussions so that unit members rather than the O/C identify unit strengths and weaknesses. It is possible, however, that discovery feedback techniques are less effective for ARNG units than for AC units, especially in time-constrained IDT.

Timing and distribution of feedback. The variation here concerns whether augmented feedback should be presented during training in the form of "extra" cues or deferred to a natural break in training. Augmented feedback (e.g., a buzzer that sounds when a gunner's sight picture is correct) tends to speed up learning but does not transfer to a nonaugmented condition (Wells & Hagman, 1989). Adaptive withdrawal (providing augmented feedback only when responses deviate significantly off course) may increase the efficiency of TADSS training.

Enhancements to long-term retention. Principles to enhance long-term retention have been established for many years. These principles include the following: (a) forgetting increases as a positive function of the retention interval, (b) over-learning is beneficial for retention, (c) relearning after a retention interval is more rapid than the original learning, and (d) discrete procedural responses are forgotten more readily than continuous motor skills (Adams, 1987).

Studies that illustrate the application of such principles (and confirm their effectiveness) would help in the development of future micro-level strategies.

Research Questions

How should TADSS-based training be implemented in the RC environment? This question considers the adequacy of components of a micro-level strategy for implementing a training approach. Since the strategy is part of the TSP, it should be evaluated in terms of clarity and acceptability to trainers.

What learning variables promote skill acquisition, retention, and transfer? Illustrative variables include AAR techniques, enhanced feedback, and application of established principles for enhancing long-term retention. The intent is to establish a framework for systematically varying characteristics when strategies are implemented so that effective principles can be identified.

Performance Measurement

The importance of performance measures has been well established for individual training. The emphasis in this area is on extending performance measurement to collective training by identifying quantifiable indices of collective performance. Two factors make collective performance measurement difficult. The first difficulty is the complex and heterogeneous nature of performance--multiple independent actions by units affect multiple outcomes, making it difficult to summarize performance in meaningful and understandable ways. The second difficulty is that collective performance measures at battalion and higher echelons may be viewed as impinging on the commander's prerogative to assess the unit. Despite the difficulties, collective performance measures are vital for diagnostic purposes and for proficiency assessment.

Diagnostic Measures

Diagnostic measures are part of the micro-strategy for a TADSS and also apply to field training such as Lanes (Ashworth et al., 1992). The Lanes concept calls for providing training support from outside the unit (e.g., AC O/Cs, pre-packaged training scenarios). In considering the need for performance measurement, it is important to remember that TADSS and field exercises do not in and of themselves provide instruction. Unless trainers intervene, typically through AARs, the exercises only provide practice. Thus the skill and expertise of O/Cs are vital components of effective collective training. Diagnostic measures enhance that expertise by providing a functional structure for AARs and objective baselines for analyzing performance.

Functional Structure

A variety of functional structures have long been familiar to Army collective training (e.g., move, shoot, and communicate). Two of the most pervasive recent structures are ARTEP-MTPs and Battlefield Operating Systems (BOSs). The ARTEP-MTPs list tasks by mission and

provide standards of performance and performance details. The BOSs are seven functional areas, adopted by the National Training Center (NTC), that encompass tactical operations. ARI has further elaborated the BOS structure through a series of projects to analyze battlefield functions (BFs), formerly critical combat functions (CCFs), illustrated for a subset of BOS in Table 2 (Ford et al., 1997).

Table 2

Sample Battlefield Functions Grouped by Three BOS

BOS		Battlefield Function (BF)	Applies to: Bn	Applies to: Bde
Intelligence	1.	Conduct Intelligence Planning	X	X
	2.	Collect Information	X	X
	3.	Process Information	X	X
	4.	Disseminate Intelligence	X	X
Maneuver	5.	Conduct Tactical Movement	X	X
	6.	Engage Enemy with Direct Fire and Maneuver	X	
Fire Support	7.	Employ Mortars	X	
	8.	Employ Field Artillery	X	X
	9.	Employ Close Air Support	X	X
	10.	Conduct Electronic Collection and Jamming		
	11.	Conduct Battlefield PSYOP		
	12.	Employ Chemical Weapons		
	13.	Conduct Counter Target Acquisition Operations		
	14.	Employ Naval Surface Fires		X
	15.	Coordinate, Synchronize, and Integrate Fire Support	X	X

Each structure has advantages and disadvantages. The ARTEP-MTP structure applies well at the platoon level and below, but the scope of task detailing may be too large at higher echelons. Given highly skilled O/Cs, the BOS structure works well at higher echelons, but most of the BOSs are too broad to guide remediation, while orienting on individual BOSs tends to obscure synchronization among operating systems. The BFs have finer detail and explicitly address synchronization across systems and units, but the level of detail makes paper-based application difficult for most O/Cs and the analyses do not have doctrinal status.

The research need is to identify the structure and level of guidance O/Cs need to diagnose unit performance by unit type and echelon. Products should include prototype observer guides based on the recommended structures.

Objective Baselines

One of the benefits of TADSS is the capability to collect large quantities of historical data concerning combined arms training events. For example, the Unit Performance Assessment System (UPAS) and the modified semi-automated forces (ModSAF) database in SIMNET automate the collection, integration, and display of performance data. The performance data have been tied to ARTEP-MTP tasks (Meliza, Bessemer, Burnside, & Shlechter, 1992). The immediate application of UPAS and ModSAF is to enhance the AAR by playing back the mission. The feedback function could be enhanced further through the development of baseline information to indicate how unit performance compares not only with previous performance by the unit, but also with other similar units. Such information would be especially useful for indicating when units have achieved gate qualifications for moving to more demanding events.

Research Questions

What level of detail is needed for diagnostic instruments? This question balances the reliability of diagnostic assessments with acceptability of the instruments. The reliability issue is: Do two or more qualified trainers who observe the same behavior agree on the unit's strengths and weaknesses? At the same time, researchers should determine whether O/Cs who conduct the TADSS-based or field-based training have sufficient flexibility to exercise their subject-matter expertise. The question might well be addressed in the context of O/C certification for TADSS-based training.

Proficiency Assessment

Assessing training effectiveness requires measures of performance both during training and on the criterion. Most designs for assessing TADSS effectiveness use TADSS-based predictor measures and field exercises as the criterion behavior. While variations are possible, that distinction is useful for discussing research requirements. Regardless of the medium, measures must be valid, targeting the processes and outcomes associated with the performance domain, and reliable, resulting in consistent results over replications of performance.

TADSS-Based Assessment

TADSS-based measures can be highly appropriate for training effectiveness analysis. These measures have fewer factors to threaten validity (compared to measures in an operational environment) and can be manipulated (e.g., lengthened) to enhance reliability. For example, Graham (1986) found that a COFT-based test of gunner performance exhibited high reliability and enabled more detailed analysis of gunnery performance than would have been possible in a field environment. Hagman and Smith (1996) developed a similar test on a later COFT version and found that the COFT test was a good predictor of live-fire performance. While the relationship between COFT and live-fire had long been assumed, that study was the strongest confirmation, in part because the sample of ARNG crews included a range of gunnery ability. Since a range in both predictor and criterion performance is needed to study transfer and

prediction, including ARNG units in the sample may help assure the needed variation. Hagman (in press) extended the analytic approach from the COFT prediction work to a rifle marksmanship TADSS (the EST) and again found a high level of prediction.

The value of TADSS-based assessments extends beyond confirming the effectiveness of the TADSS. The assessments also enable efficiencies in unit training by (a) identifying crews and individuals who are ready for live fire (Hagman, in press; Hagman & Morrison, 1996), (b) supporting development of combat attrition models (Graham, 1986), and (c) helping in the selection of ARNG crewmen (COL R. Krug, personal communication, December 12, 1996). Research support of TADSS-based assessment should include documenting and improving psychometric properties of the measures and establishing standards that indicate gates for moving to more difficult exercises or to an operational training environment (e.g., FTX, live fire).

Operational Measures of Effectiveness

Studies of training effectiveness ultimately require measures of effectiveness (MOE) on operational equipment in a realistic environment. Because of the desire for high content validity, researchers will often look to highly realistic training environments, especially instrumented combat training centers (CTCs), for MOE for training effectiveness analyses. The problem comes when researchers try to use O/C comments and instrumented data as criterion measures. It is rare when measures designed for diagnosis are also appropriate to be MOE.

In some cases, "normally" generated CTC data have been suitable for criterion purposes. For example, casualty exchange data from several years at the NTC showed a significant relationship to operating tempo (OPTEMPO) estimates (Hiller, McFann, & Lehowicz, 1990). In most cases, however, the experience reported by Rand researchers applies: "For every. . .study we have done at the NTC, we have had to develop data items and collection methods specific to the study" (Hodges, 1994, p. 451). As an example, researchers in ARI's Project Determinants developed separate rating forms targeted to a given echelon (e.g., platoon) which the O/Cs agreed to complete (Keesling, Ford, & Harrison, 1994). As another example, Institute for Defense Analyses (IDA) scientists and SMEs directly observed ARNG units at NTC and rated their performance during rotations in 1996 (Dr. Morrison, personal communication, February 7, 1997).

A review of cost-effectiveness analysis across Services (Simpson, 1995) found development of MOE for collective training to be a fragmented area that "remains an art rather than a science" (p. 18). Simpson offered eight generalizations to guide the art: (a) tasks tend to exist in structures (e.g., hierarchies, functional categories); (b) the structure requires definition; (c) tasks at each level require definition; (d) interactions among levels require definition; (e) tasks should be selected which focus on the interests of the training-effectiveness analysis; (f) tasks are converted to MOE; (g) product MOE (mission accomplishment) are the most important; and (h) process MOE assess the internal workings of the collective unit.

As described earlier, most structures for Army collective training are based on operational functions. The structures might be more suitable for assessment if they are augmented by cognitive analyses that define the interactions of knowledge, cognitive processes, and behavior in determining performance (J. P. Campbell, 1991). For example, assessment of team processes might be structured into components such as leadership, communication, adaptability, and coordination and cooperation (Swezey & Salas, 1992).

ARI's work related to BFs has included development of assessment packages that are consistent with Simpson's generalizations: the structure of tasks is defined functionally, tasks at each level are defined, interactions between levels and across operating systems are defined, and product and process MOE are presented (Ford et al., 1997). The assessment packages are structured to support assessment at increasing levels of specificity:

BF:	Direct and lead unit during preparation phase of battle (BF 19).
Outcome:	Subordinate leaders demonstrate an understanding of the mission, commander's intent, and mission essential tasks.
Component:	Briefback or rehearsal.
Task:	Brigade S3 ensures brigade combat power is synchronized in terms of timing to support brigade movement and maneuver.

The assessment packages have been implemented on only a partial basis to assess field training (e.g., IDA used task definitions to assess process of ARNG battalions at NTC).

Most assessments of collective tactical training include process MOE, such as checklists based on ARTEP-MTP task definitions. Such paper-based tools can be imposing and cumbersome. Two lines of research can facilitate process measurement. The first line of research is to provide information to focus assessment on critical requirements. To some extent, identification of tasks to be observed depends on the unit's level of qualification and requirements of the METT-T. Development of MOE for individual tasks is frequently guided by assessments of task criticality for a variety of METT-T conditions. Similar data on collective tasks would be useful.

The second line of research is to develop computer-based tools to support task-based assessments. An example of such a tool is the Electronic Collection Instrument (ECI), sometimes called the electronic clipboard. ARI demonstrated the potential of the ECI during Army Warfighter Experiment Desert Hammer VI in 1994. That work demonstrated the capability to use ECI to record data in the field and upload it to a central database via radio. Despite that proof of principle, the ECI was not accepted by O/Cs. When given an option of collecting follow-up data using ECI or a paper-based format, almost all O/Cs chose paper. Advances in technology will certainly enhance the practicality of tools like ECI (e.g., improving readability of the monitor in bright light), but if computer-based tools are to be applied for training effectiveness assessments, researchers must still consult with O/Cs during the design of the application.

Research Questions

How should performance assessment measurement systems be structured? Two research angles are involved in addressing this question. The first looks at the effect of augmenting functional analyses with cognitive analyses and empirical data on criticality. The second considers how a measurement system might be implemented, including product and process MOE. The acceptability of the full system should be considered, with the crucial opinions coming from unit commanders and TRADOC proponents.

What is the reliability and validity of MOE? The purpose of assessing the psychometric properties of MOE is to identify and, ultimately, control measurement errors that may be introduced from the context of performance and from methods of measuring. While reliability and validity are concerns in TADSS-based and operational MOE, the TADSS-based MOE are more appropriate media for studying reliability and validity issues. The benefits of TADSS-based MOE result from the possibility of including multiple replications of unit performance, enabling the application of structural equation techniques (e.g., LISREL) and generalizability theory.

Training Management

The Standard Army Training System (SATS) is an automated training management system that is a major component of the Army Training XXI campaign to produce a training system for an information-age Army (Dugan, 1997). SATS will support training development and scheduling by assisting commanders and other unit trainers in the production of training schedules, calendars, plans, resource requirements, evaluations, assessments, and readiness reports. ARI can support the implementation of SATS in the RC by developing macro strategies for ARNG units and developing and maintaining a performance-oriented database.

Macro-Level Training Strategies

A training strategy is the systematic configuration of instructional content and methods intended to enhance training effectiveness (Morrison & Hagman, 1994). The highest level is a macro-level strategy that lays out a unit's long-term training program (e.g., armor battalion 2-year strategy). The basic macro-level strategy for Army unit training is established by the Combined Arms Training Strategy (CATS) (U.S. Army, TRADOC, 1992b). CATS presents events for various battalion types and explains how the event-based strategy interfaces with the related process of training development, budget management, requirements determination, and materiel acquisition. The resourcing model for training, the Battalion-Level Training Model (BLTM), is based on CATS. In order to revise BLTM to reflect savings from existing TADSS (e.g., Janus, SIMNET) and emerging TADSS (especially CCTT), ARI was asked to develop a new CATS. The resulting task-based CATS provides more complete descriptions of training: identifying tasks to be trained by each event at each echelon, specifying the frequency with which tasks must be trained to sustain readiness, and laying out a menu of events and media to train the tasks (Keenan et al., 1996). The macro-level strategy for a particular echelon of a particular unit (e.g., a battery of a field artillery battalion) is laid out as a matrix in which the

tasks to be trained, identified in the first column, define rows that are completed with entries for each of the columns laid out in Figure 1. Matrices were developed for each echelon (battalion, staff, company, platoon, squad/crew) for 11 battalion types. The matrices and supporting 2-year calendars were validated with proponent schools, battalion commanders in Forces Command (FORSCOM), and battalion commanders in U.S. Army Europe (USAREUR).

Task	Freq./ Interval	Means (Event) (Media)	Estimated Duration	Quality (A-D)	Training Unit (Audience)	Prerequisite Training (Gates)	Remarks (Includes purpose of event; outcome being supported; comments about execution of the event; constraints posed by TADSS; etc.)

Figure 1. CATS model data elements.

Three of the conclusions from CATS development suggest that those strategies might profitably be adapted for RC training. First, the CATS matrices were found to facilitate the development, communication, coordination, and resourcing of task-based training strategies. Second, the CATS showed potential savings from integrating TADSS (e.g., 8% reduction in tank mileage for a T-1 armor battalion over a 2-year cycle). Third, leaders and trainers considered the prototype matrices to be accurate, complete, and useful (i.e., "road map to planning and execution of battalion training") (Keenan et al., 1996).

Commanders and other unit trainers will be able to access CATS for the 11 battalion types with the introduction of SATS 4.1. The CATS analyses is currently being extended for AC brigades.

RC training would also benefit from a macro-level strategy that clarifies how TADSS should be integrated into unit training. The strategy might be an especially useful tool for implementing a lower-echelon emphasis such as BOLD SHIFT (Ashworth et al., 1992). The most efficient way to develop such a strategy would be to adapt the battalion CATS matrices and calendars for RC units. One requirement for the adaptation is to determine the cycle and culminating events to be addressed. The AC analyses, which focused on T-1 units, used a 2-year cycle tied to a CTC rotation for all units. Greater variation may be required for RC battalions.

After the matrices are adapted, researchers should monitor their application in a sample of units. One of the concerns during the monitoring will be to document the impact of basis of issue of a TADSS on the implementation of TADSS training. This is a vital concern for projecting cost savings in the RC. For example, work with battalions in Europe found that units located more than 2 hr from a SIMNET site rarely incorporated that TADSS (Keenan et al., 1996). At a minimum, extensive travel to a TADSS will reduce the number of tasks or repetitions in the training.

Research Questions

What tasks should be trained in TADSS-based and field events during an RC unit's training cycle? Answering this question involves systematic review with proponent agencies and experienced commanders to convert CATS matrices and calendars that have been developed for the AC to RC battalion types. The conversion includes defining a meaningful training cycle and culminating event for each battalion type. For example, an enhanced armor battalion might have a 1-year cycle culminating in a platoon battlerun. Each macro-level strategy should be implemented in at least one RC battalion to confirm its practicality.

How does the basis of issue of TADSS affect the macro-level strategy for RC units? The immediate purpose of this question is to guide distribution of TADSS. In addition, answering the question will help identify alternatives to the macro-level strategy in the event that projected TADSS are not available.

Database Development and Maintenance

ARI has developed a prototype database for ARNG armor and mechanized infantry units that illustrates the potential for extending current SATS components to include information on resources and performance. The ARI database is designed to support development of gunnery training strategies by documenting TADSS implementation and training usage, measurement of TADSS performance, and relevant criterion measures (R.E. Jones, 1996). The scope of data by level is illustrated in Table 3 (Keesling & Clifton, 1994). The database was populated with data for eight ARNG brigades for FY94.

Table 3

Scope of Data in Training Management Database

Level	Sample Data
Individual	Time in service
	Armed Forces Qualification Test
	Individual weapons qualification
Crew/Squad	Gunnery table scores (preferably first run)
	COFT attainment level
Company	Fuel consumption
	Training Assessment Model (TAM) ratings
Battalion	TAM ratings
	Ammunition usage

Keesling and Clifton (1994) identified how such data can be analyzed to support training management. The description of prototype analytic approaches was described in terms of the adaptation of a model of applied research developed by Wold (1970) shown in Table 4. The general categories of approaches include nonexperimental and experimental description, nonexperimental explanation, and experimental explanation.

Table 4

Ends and Means in Applied Statistics

Ends	Means	
	Nonexperimental	Experimental
Description	Descriptive statistics Confidence intervals Longitudinal descriptions	Same means, with focus on differences among experimental conditions
Explanation	Causal inference from quasi-experiments Time-series Multiple time-series Causal models for nonexperimental data	Comparison of treatment conditions Factorial experiments Analysis of variance

Nonexperimental and Experimental Description

Description analyses use arithmetic and graphical techniques to control random fluctuations. The difference between the nonexperimental and experimental means depends on whether units can be assigned randomly to experimental conditions. The techniques help assess effects of moderating variables (e.g., crew turbulence) and monitor trends in performance indicators (e.g., gunnery table scores and COFT reticle aim level). Such descriptions can improve training management by providing feedback so that commanders can compare their current training program with programs from previous years and determine whether quality of performance changes.

Nonexperimental Explanation

The first set of nonexperimental explanations--time-series methods--are a variation of trend line analysis. They come into play when a change in policy or practice is introduced. Keesling and Clifton (1994) suggested the example of the introduction of the Guard Unit Armory Device Full-Crew Interactive Simulation Trainer--Armor (GUARDFIST I). If Tank Table VIII (gunnery qualification) scores over several years were available for a battalion, the time-series design would monitor whether the anticipated improvement in Tank Table VIII scores occurred. If GUARDFIST I were introduced to some battalions before others, a multiple time-series design would add a comparison of performance trend lines for units with the TADSS to those without the TADSS.

Changes to training execution will usually occur in response to deliberate decisions, for example implementing innovations from the Simulation in Training for Advanced Readiness

(SIMITAR) program (Krug & Pickell, 1996). The research task in such cases is straightforward--identify the resources and performance likely to be affected and compare the trend lines before and after the introduction of the innovation. Sometimes, however, the change may be gradual (e.g., changes in ability levels). Then researchers have a chance to uncover the factors that contribute to the change in the trend line (e.g., economic conditions, modifications to recruiting).

Since the trend lines document natural variation without the random assignment required for experimental treatments, it will usually be necessary to consider whether other trends might be influencing the results. Causal models and regression analysis techniques applied to multiple units help document the impact of potential moderating variables, such as ability level and turbulence.

Experimental Explanation

In some cases, Army planners will implement experiments in which units are assigned at random to treatment conditions and the effects of the treatments are documented. For example, plans for the SIMITAR initiative included experimental and control battalions in rotations to NTC (Krug & Pickell, 1996). Even though most experimental designs do not depend on maintaining data over a long time period, the database can support such experiments by documenting the extent to which the training intervention was implemented (e.g., TADSS usage) in experimental units and describe comparable training programs for the control units.

Research Questions

What interventions or interruptions have an impact on unit performance? This is the fundamental question to be addressed by the ARI training database. Answering it requires a substantial commitment, at least for early prototype analyses. Research should assess the impact of planned events and include the monitoring of trend lines to detect evidence of changes to resources or performance and development of hypotheses for causes of those changes.

How can the armor/mechanized infantry database be maintained and accessed? Under current conditions, the database requires a great deal of attention to update information on current battalions and to extend the number of battalions covered. Data from sources such as the Standard Installation/Division Personnel System (SIDPERS), COFT, battle rosters, and drill attendance should be added monthly or quarterly. Those sources are currently in a paper-based format and must be entered by hand. Research should be directed toward developing interfaces with the data sources, perhaps through the Reserve Component Automation System, to enable digital transfer of data.

Compiling data requires substantial support from units. The first requirement for securing and maintaining that support is to ensure that units obtain direct pay-off from the database. During the initial stages, this requires frequent coordination between ARI researchers and unit trainers to provide status reports and prototype analyses. At a later stage, the database would be most useful if unit trainers could retrieve information directly in a user friendly format.

The current structure for retrieving information (Statistical Package for the Social Sciences--SPSS) requires assistance by a researcher. The ultimate goal should be access through SATS, but interim solutions should be identified. Research should consider development of standard queries, graphical support, and Internet access.

A further requirement for securing unit support for the database is to protect units from comparisons that might embarrass their leadership. In early stages, this protection requires monitoring by researchers. When units have direct access, the database will require security procedures that prevent identification of other individual units.

How should variables be aggregated for a collective training database? Much of the information on individual, crew, and squad level characteristics and achievements will need to be aggregated for comparison to performance indicators for higher level units. For example, an analysis of the relation between individual ability and platoon battlerun performance might aggregate ability measures in three ways (Ford & Keesling, 1994): (a) mean Armed Forces Qualification Test (AFQT) of crewmen, (b) percentage of high ability crewmen (AFQT Category 1 and 2), and (c) percentage of low ability crewmen (AFQT Category 3B and 4). Research would consist of analyses using various aggregation schemes and provide guidance on which to apply under given conditions.

Distance Training

This domain includes approaches for distributing instruction to physically dispersed students. The major application is DL for individual training, typically used as an alternative to resident training. An emerging application is Distributed Interactive Simulation (DIS) for collective training.

Distance Learning

ARI's support of DL has included development and evaluation of content for the full range of RC individual training: (a) professional military development (e.g., leadership training), (b) reclassification (initial training for prior-service personnel whose military experience does not qualify them for their RC duty positions), (c) skill progression (preparation for more advanced jobs in their fields), (d) functional needs (e.g., counter-drug operations), and (e) special skills (e.g., combat lifesaver). Most of the current work is being conducted in support of DL regional networks established by the National Guard Bureau in response to a directive from the National Defense Authorization Act of 1995. The intent is to establish regional networks having a DL classroom site within a 90-min commute for all ARNG soldiers (eventually to be within 60 min). Each site will have an audio teleconferencing station, a multi-media personal computer, an interactive graphic tablet and software, a video satellite downlink, a videotape player/recorder, and a 35" television monitor. Some sites will also include a network of 12 multi-media personal computers. Continued support of DL for RC training should include conversion of courses to DL, development of guidance on DL delivery methods and media, assessment of cost effectiveness of DL, and development of guidance on DL procedures.

Course Conversion

Army leaders have identified 532 courses that are appropriate for complete or partial conversion to a DL mode of delivery. Much of the impetus for the planned conversion is to increase the level of military occupational specialty qualification (MOSQ) in the RC. As summarized in Table 5, about twice as many soldiers who require MOSQ training could be trained each year when those courses are converted to DL (Metzko, Redding, & Fletcher, 1996).

Table 5

Requirements for Resident Courses for Army RC Personnel

Reserve Component	Number of Courses		Number of RC Personnel (FY95)	
	Total	Convertible All or in Part to DL	Needing Courses Identified as Convertible to 67% DL	Likely to Receive Residential Instruction in FY
ARNG	1,600	532	12,606	8,096
USAR			24,095	10,104

The first area of research support is to accelerate the rate of conversion of courses. One way to support the conversion of courses is continued assistance with monitoring course conversion and evaluating effectiveness of the DL network. When institutional courses are converted for ARNG use, they are restructured to fit into a maximum of 48, 4-hr blocks with no more than 15 days of accompanying resident training. For example, the course for MOS 93C (Air Traffic Controller) is being conducted with 21 students from eight states. The course includes a DL portion plus 2 weeks of resident training to cover tower operations and radar (R. Wisher, personal communication, February 10, 1997). Regulations governing DL mandate that such courses are to be evaluated as they are implemented (U.S. Army TRADOC, 1996). Such evaluations should include course performance indices, student opinions, and completion rates.

In addition to accelerating the rate of course conversion, research should also expand the scope of conversion. Most Army courses are to be only partially converted to DL. As shown in Table 6, only seven courses are projected to be delivered in a completely DL mode (Metzko et al., 1996). In contrast, Air Force and Navy plans call for conversion of all courses to 100% DL. With the partial conversion, most RC personnel in DL courses will be required to travel to a resident training site. While there are cost implications for such travel (estimated at $800 per person), the major concern is that the resident requirement increases the difficulty for RC personnel to receive the training: 15 days is less of a problem than 8 weeks, but it is still a problem.

Table 6

Planned Conversion of Army Courses to DL

Percentage of Courses Converted to DL[a]	100	94	80	70	67	50	40	33
Number of Courses	7	4	157	177	43	3	6	135
Percentage of 532 Courses	1	1	30	33	8	1	1	25

[a]Measured in hours of instruction

Research on increasing the amount of DL should test the implied assertion that resident training is needed to facilitate learning as students help each other. For example, work with Asynchronous Computer Conferencing (ACC) found that benefits from group work could be achieved in a DL mode (Phelps, Ashworth, Wells, & Hahn, 1991). For cases in which resident training is justified on the grounds of a need for psychomotor skill training, research should assess the recommendation by the Total Force DL Action Team and the Guard/Reserve Subcommittee to provide cognitive skill training through DL and conduct skill training during monthly inactive duty training (IDT) and AT (Metzko et al., 1996).

Methods and Media

The emphasis on video transmission capabilities in the regional demonstration network and the wide-spread use of video teletraining (VTT) by the Army and other Services may lead to a tendency to equate DL with VTT. In fact, Army plans for the DL courseware for the RC calls for only about 10% of the projected hours to be devoted to VTT, with about half of the projected hours to be devoted to interactive media, such as computer-based training (CBT) and interactive videodisc (IVD)/compact disc (CD). This emphasis is encouraging since interactive courses are consistently found to be more effective and efficient than conventional resident courses (Fletcher, 1990; Johnston & Fletcher, 1997).

The incorporation of media other than VTT enables a fundamental decision on DL delivery: whether training will be delivered in a synchronous or asynchronous mode. Synchronous delivery requires simultaneous "real time" interaction between the instructor and the student. In contrast, asynchronous delivery takes advantage of interactive media and computer conferencing so that the instructor and student do not have to interact concurrently. Asynchronous delivery is especially desirable in the RC because it allows more flexibility for RC personnel to schedule training around their civilian commitments. The TECHSELECT decision aid (Hagman & Dykstra, 1988) guides delivery mode decisions based on considerations of the training load (e.g., fewer than 10 participants across three or more time zones argues for asynchronous delivery) and general strategy (e.g., lecture argues for synchronous delivery).

Guidance on method selection should be extended to include analysis of the training content tied to the medium best suited for the content. Research to provide that guidance should consider emerging videographic and audiographic technologies and determine the optimal utilization of the technologies (Pugh, Parchman, & Simpson, 1991).

Cost Effectiveness

Research on cost effectiveness should document effectiveness of DL compared to resident training, establish costs for DL conversion and delivery, and establish costs for resident training.

DL effectiveness. Research on DL effectiveness should extend beyond determining whether student achievement under DL is at least equivalent to student achievement in a resident training environment. That issue is well established: "The efficacy of DL technologies. . .has been demonstrated in the military, academia, and the commercial world by more than 300 studies" (Metzko et al., 1996, p. V-1). As described in the section on DL conversion, effectiveness data must be collected as part of the tryout of new instruction. The point here is that the design of the required effectiveness studies should also enable an assessment of the impact of variables that affect the quality and cost of DL, for example, feedback, quality of materials, variety of media, and class size (Hahn, Ashworth, Phelps, Wells, Richards, & Daveline, 1991).

As an illustration of how assessment of DL effectiveness can inform decisions on methods and media, consider two recent studies of variations in VTT. The Army Teletraining Network (TNET) project studied strategies for delivering leader training in the Basic Noncommissioned Officer Course (BNCOC) that included one-way video, two-way audio (1V, 2A) and two-way video, two-way audio (2V, 2A). Students in the 1V, 2A condition performed as well as students receiving traditional instruction and better than students in the more expensive 2V, 2A condition (Wilson, 1992). The Army Logistics Management College (ALMC) study compared cost per student in resident training with costs for training with on-site instructors (save 56%), analog satellite (save 70%), and compressed digital video (save 79%) (Redding & Fletcher, 1994).

DL costs. Research on cost effectiveness requires credible measures of the costs to convert a resident course to DL. When the Total Force DL Action Team and the Guard/Reserve Subcommittee collected estimates of conversion costs from the Services, the range of estimates was very wide. The uncertainties about conversion costs are illustrated in Table 7, which applies the estimates to projected Army course conversions (Metzko et al., 1996).

The 400% range of conversion costs in Table 7 suggests either that there are substantive differences in the way Services implement the media or that estimates are based on limited examples. In either case, more accurate conversion costs based on actual experience is required. An example of the level of detail required is documentation of the new lesson plan, new student aids, new instructor guide, and validation of lessons (Hahn et al., 1991). Even with uniformly low estimates, conversion is a significant cost that should be given more support in DL funding decisions. Metzko et al. (1996) reported that about 5% of the funds expended on VTT in the Army for FY94 were devoted to preparing courseware; less than 10% of the funds allocated for

Table 7

Cost to Convert Army Resident Course Candidates to DL Media

	Hours	Cost per Hour (CPH)[a] ($)		Cost to Convert ($ thousand))	
		Low	High	Low	High
Print	15,932	1,300	5,000	20,712	79,660
Videotape	10,572	8,300	17,000	87,748	179,724
CBT	22,575	4,000	14,000	90,300	316,050
IVD/CD	17,564	4,000	19,000	70,356	333,716
VTT	9,771	260	19,000	2,540	185,649
Total[b]				271,656	1,094,799

[a]CPHs are highs and lows of all Services' estimates, except for VTT (Navy CPH was 0).
[b]Does not include Army "other" category, about 8,500 hours devoted to audio conferencing, with high and low CPH of $10,000.

the regional demonstration network in FY95 were designated for courseware. Research that identifies the scope of conversion activities and establishes credible cost projections would support arguments for increased funding for course conversion.

Costs for delivering DL should also be documented. For ACC, these costs include production of materials, procurement of equipment, training of instructors, shipping of materials, and operating and support costs (e.g., instructor salaries). An innovation in the ACC cost effectiveness analysis is the development of a rubric of cost per 50 graduates, which, when compared to a similar figure for resident training, accounts for through-put differences (Hahn et al., 1991).

Cost effectiveness comparisons between DL and resident training obviously require data on resident costs. Direct costs are easy to calculate: travel and per diem, instructor costs, and training material. More difficult calculations would consider the marginal infrastructure costs, such as training developers, training equipment, and school operations. The ultimate benefits for RC training relate to opportunity costs and increases in readiness.

Administrative Guidance

As experience with DL accumulates, issues concerning the relation between the way courses are administered and their effectiveness will arise. Three such issues are instructor selection, control practices that facilitate completion, and reimbursement of DL participants.

Instructor selection. The characteristics and experience that make an instructor effective in a resident training environment may not apply for the DL environment. For asynchronous

training, the instructor's role is redefined. In resident training, verbal interactions are monopolized by the instructor (60% to 80%). In contrast, the instructor is less verbal in an asynchronous mode; for example, only 10% to 15% of class dialogue in ACC is contributed by the instructor (Davie & Wells, 1992). The revised role requires instructors to encourage student participation through positive reinforcement or by designing assignments that provoke participation. In synchronous DL, the instructor's role is similar to the role in resident training but may be more demanding. For example, a review of VTT literature for the Navy concluded that students expect instructors to be equivalent to moderators in programs on commercial television--dynamic actors with a sense of humor--as well as SMEs (Bailey, Sheppe, Hodak, Kruger, & Smith, 1989).

Facilitating completion. A consistent advantage of resident training over DL is that more students complete training in a resident environment. Causes for that advantage include fewer disruptions for students (e.g., from civilian job demands) and the shorter schedule for resident training, which reduces the chance that crises will force the student to drop out. There are, however, student motivation variables that increase completion of asynchronous DL: (a) high student-instructor interaction, (b) a flexible but firm schedule, (c) group activities, and (d) incentives and sanctions (e.g., bonus points for early lesson completion and deductions for being late). For synchronous training, it may be possible to shorten the time frame for the course by lengthening the VTT sessions beyond 4 hours within a 24-hour period. For example, the Army TNET Study found that students in the 2V, 2A condition taught over 7 days performed as well as students trained over 4 months (Wilson, 1992).

Reimbursement. The third administrative area that affects the success of DL concerns reimbursement of students. Enlisted personnel and officers in resident training receive their active duty pay while at the training site. In a DL mode, only enlisted personnel receive active duty pay. For synchronous training, they can be paid based on the length of the DL session. For asynchronous training, the question is whether reimbursement should be based on completion of course requirements or total time devoted to DL.

Research Questions

Although the effectiveness of DL has been well documented through case studies (Wells, 1990), there has been comparatively little effort to design studies that extend the findings to other DL efforts. Notable exceptions to this tendency are the Army's work with ACC (Hahn et al., 1991) and the Navy's work with VTT (e.g., Simpson, Pugh, & Parchman, 1993). These exceptions demonstrate that studies whose immediate purpose is quality assurance for DL courseware also provide opportunities to introduce systematic variation in the design to address broader questions. Four of these questions are recommended below.

What is the most cost-effective combination of media in DL? The answer will depend on characteristics of the tasks, the training audience, and the delivery environment. The anticipated product is a computerized decision support tool, similar to TECHSELECT (Hagman & Dykstra, 1988), with an emphasis on taking advantage of interactive media in course conversions.

What types of interactivity are required in DL? Research related to this question will identify the types of students and tasks that require interactive presentation and the types of interactions required (e.g., whether with the instructor or with other students). For asynchronous training, variables should include frequency and type of group activities and frequency of contacts with the instructor. For synchronous training, the major variable will be video and audio alternatives: in descending order of cost, 2V/2A, 1V/2A, 1V/1A, and audiographics (two-way audio and still-frame graphics that can be annotated). The scope of the question also includes documenting the benefits of resident requirements for part of the course (rather than full DL).

What skills are required for instructors to be effective in DL? For synchronous delivery, the question should address the importance of presentation skills of the VTT instructor and characteristics for effective on-site facilitators. For asynchronous delivery, the question should consider skills to encourage participation. The answers should guide instructor training as well as selection of instructors.

What savings can be anticipated from DL? Answering this question involves collecting and aggregating data on infrastructure costs for both resident and DL training, travel and per diem costs, resident training costs, costs to convert conventional courses, and expected improvements in training efficiency and personnel readiness (Metzko et al., 1996). Since the content of much training applies to the Total Force, savings should be projected for AC personnel and civilians as well for RC personnel.

Distributed Interactive Simulations (DIS)

This section describes research on extending the application of technology to support DL of individuals to the support of collective training of dispersed units. The research should consider DIS possible with current technology and ways to refine distributed interactive training technologies for more realistic interactions.

Current DIS

The "virtual classrooms" established to support individual DL also can be used for DIS for collective training. Work by ARI has demonstrated that a brigade-level CPX in DIS can achieve comparable results with substantial savings over a field CPX. The demonstration used relatively unsophisticated long distance technology (e.g., slow-scan television transceivers, facsimile machines, and commercial telephones) and the Computer Assisted Map Maneuver Simulation (CAMMS) as the battlefield simulator (Smith, Hagman, & Bowne, 1987). Using the "virtual classroom" for video teleconferencing (VTC) among staffs and the more advanced Battalion Brigade Simulator (BBS) should allow current RC battalions, brigades, and divisions to achieve comparable or improved results. In fact, an ARNG brigade commander who was interviewed for this project considered VTC to be "the most important step in ARNG training since the 1950s," specifically citing the capability of conducting staff training for all battalions in the state without travel requirements (COL Youngman, personal communication, December 12,

1996). Research on the effectiveness of DIS for staff training would demonstrate the savings to be anticipated and establish procedures to implement the training.

Refined DIS

As part of SIMITAR, ARNG trainers are developing procedures to link Janus in a wide-area network (WAN) to support a CPX. The advantage of the WAN is that all echelons down to battalion are required to exercise the command and control function. Since current software cannot support the WAN application, interim training will be conducted using parallel Janus sets. When constructive tactical engagement simulations (TES) (e.g., Janus and BBS) can be conducted in a WAN, it will be possible to conduct virtual TES, such as SIMNET and CCTT, in a DIS mode.

Research Questions

What savings can be achieved by conducting collective training in a DIS mode? This question concerns current DIS technology. The first need is to determine whether constructive simulations can be delivered effectively using the current VTC capability in the ARNG and current constructive simulations. Assuming that the training will be effective and efficient, research should focus on development of scenarios and TSPs for the training.

How can TES systems be integrated to support training in a DIS mode? Research related to this question requires the design, development, and evaluation of software that enables systems from geographically distributed sites to interact in real time.

Concluding Comments on the Training Research Domain

The dominant theme in the preceding discussion of training research has been optimizing TADSS and DIS to increase training time and effectiveness. Given the constraints of the RC environment, these are important research areas. But simply having a TADSS does not create effective training. They must be appropriately designed and implemented. The research suggestions above have been offered to address both of these issues. Clearly, none of the training problems faced by the RC is simple. Tasks at the individual level are complex and varied so soldiers must work hard to keep their proficiency levels up. Collective tasks are even more complex and difficult to maintain. Any loss of training efficiency is difficult to overcome in the RC. Therefore, even the seemingly mundane questions that have been addressed over and over by applied training researchers must continue to be addressed. ARI must continue its close involvement in evaluating developing TADSS. It is only though close involvement in the development process that researchers can begin to understand both the potential and the limitations of new devices.

Rigorous empirical research in the RC environment (or the active Army for that matter) is however, very difficult to conduct. Researchers are often simply not given the control required. On the other hand, researchers can have an impact on training effectiveness though less structured means. Action research models, which encourage exploration and demand continuous monitoring

of system functioning, provide an alternative method for learning about the utility and effective use of promising TADSS. Unfortunately, such approaches do not lead to quick answers. Furthermore, action research requires that training managers treat implementation decisions as experiments to be followed closely and adjusted as necessary. This model may be counterintuitive to the culturally reinforced decisive nature of the active army, and it is contrary to the rigorous experimental design tradition. On the other hand, the model may be more acceptable to RC officers who are increasingly being exposed to total quality management (TQM) methods of action research. TADSS are increasingly complex; consequently the chances of implementing them optimally, without some extended period of experimentation, is increasingly unlikely.

Perhaps not surprisingly, project interviews did not uncover an abundance of exciting new ideas for training research. In our experience, however, non-researchers tend not to spontaneously think of conducting research, even action research, as a problem-solving approach to organizational issues. That is not their aggressive cognitive "style" (Sternberg & Grigorenko, 1997). On the other hand, we will take the liberty of suggesting a few ideas that are at least a step outside the programs that ARI has been pursuing.

Research Questions

What are the effective training delivery techniques? Recent research has given little detailed attention to training delivery techniques. As observers of hours of AC and RC training implementations, we have seen wide variations in delivery methods, even among instructors using the same TADSS. For example, Graham and Smith (1991) noted the variety of techniques that UCOFT instructors used to teach and coach tank gunnery crewing, even though they were all following the same basic UCOFT matrix progressions. Most TADDS tend to have operators or instructors that, through their interactions with and instructions to the soldiers, have an influence on the quality of the instruction. ARI might begin this research area by offering to play a technical assistance role for some particular TADDS (e.g., mobile SIMNET, AFIST, or UCOFT). In this capacity, researchers could develop two or three alternative techniques for instructors to use and then build a method for obtaining feedback on how the techniques worked. An action research model, making the work a collaborative effort with the instructors, would be suitable. We suggest that ARI ground its alternative recommends on recent cognitive psychology models of knowledge acquisition (see Hoffman, 1997, for an example related to brigade staff training).

What is the training delivery capability of the Internet? The Internet is here to stay and provides a potentially powerful vehicle for training delivery. This second new research area is related to the above suggestion in that both pay attention to the details of instructional delivery. The hypermedia capabilities of the Internet naturally lead to research concerning alternative structures and organizations for delivering information in a way the best facilitates learners gaining familiarity with important concepts, and then being stimulated into the reflective thought needed to create organized conceptualizations of the topics.

Are there alternative evaluation models? This suggestion is stimulated by our previous observation on the difficulty of conducting research according to the standards set by Boldovici

(1987) and Hoffman and Morrison (1992) and by recent thinking on evaluation models by Alliger, Tannenbaum, Bennet, Traver, and Shotland (1997) and Kraiger et al. (1997). Neither what Boldovici or Hoffman and Morrison have proposed are very realistic in light of the climate of the RC, AC, or anywhere else for that matter. Alliger et al. and Kraiger et al. are envisioning alternative views. Additional thinking for the RC environment, however, is recommended. Although a step removed from immediate results for the RC, ARI should consider spending time reflecting on feasible research strategies for real-world training questions. By all appearances, as much training evaluation work occurs in the military as in private industry. Therefore, ARI is poised to take a leadership role in this area. Program evaluation theorists have been wrestling with these issues since D.T. Campbell and Stanley (1966), and there is a rich literature base for stimulating thought. The kinds of social programs they are often attempting to evaluate are every bit as complex as any training program in the Army. The action research ideas, which are part of the organizational development and TQM literature, are also applicable. This literature recognizes and tries to accommodate the control issues that continually confront evaluation research.

MANPOWER AND PERSONNEL RESEARCH DOMAINS

In this part of the report, attention shifts from training, an area in which ARI has contributed a great deal of R&D in support of the RC, to manpower and personnel, areas in which ARI RC-specific research has been more limited. It is also true, however, that there are rich research literatures related to several of the domains discussed in the following sections that, when combined with the RC work ARI has conducted, yield a substantial foundation for future research.

Recruiting

Historically, recruiting into the RC has not been a priority concern. And during the high point of the drawndown in the AC, both the Guard and the Reserves benefited from the unusually high numbers of prior service individuals that came into the recruiting market (Kirby & Buddin, 1996). But the recruiting environment is rapidly changing, making recruiting for the RC more of a challenge. For example, there is a steadily decreasing propensity to serve in the armed forces, particularly among black youth (OASD, 1996). Guard personnel are particularly concerned that those who do serve are increasingly motivated by incentives other than patriotism, making their commitment to the service more tenuous. And even though the U.S. is not at war, the increasing likelihood that soldiers will be deployed for a variety of other missions can also be expected to impact recruiting success. The types of missions (e.g., peacekeeping in inhospitable locations) and the number of missions are both potential issues here. Another anticipated change that is likely to affect recruiting strategies is the increasing percentage of combat service and combat service support positions relative to combat positions. Such changes in responsibilities will influence the types of persons interested in serving.

In contrast to the AC, deployments are often on a volunteer basis for Guard and Reserve personnel. Accordingly, we must be concerned about recruiting for such special assignments, as

well as recruiting into the force. Recent experiences with such deployments indicate that there is much to be learned about improving the recruiting processes associated with them.

The Guard and Reserves have each taken measures on their own to address concerns in the recruiting arena. For example, the Office of the Chief of the Army Reserve (OCAR) has commissioned several studies related to recruiting and retention, some of which are described below. The Guard has taken a more operational approach to dealing with the situation by consolidating recruiter and retention NCO career fields (00E and 79D) into a new "Strength Management" NCO career field. This effort to explicitly link recruiting and retention strategies is sensible, since efforts to increase recruiting success could ultimately lead to increased attrition, trading off short term gains for long term losses.

Additional research has been conducted by agencies other than Department of Army (DA), most particularly DoD. This work has been related to a number of areas, including enlistment decision-making, projections of youth market characteristics, and recruiter attitudes and effectiveness. A large proportion of this work has been (or is being) performed by the Rand Corporation. Several related pieces of research have also been conducted by researchers at the Naval Postgraduate School, primarily for the U.S. Army Recruiting Command (USAREC).

Much of the literature referred to in this section is described in a report available from the Defense Manpower Data Center (DMDC), *Compendium of Annotated Military Manpower Market Research Abstracts* (Barnes, Dempsey, Gaskins, Knapp, Lerro, & Schroyer, 1991). Though somewhat dated at this point, this report includes a comprehensive collection of detailed abstracts and evaluations of military marketing research conducted prior to 1990.

Army Research

Perhaps the most extensive study related to Army recruiting is the New Recruit Survey (NRS) program initiated in the early 1980's by ARI in support of USAREC (e.g., Levine, 1987; Westat, 1986a,b,c). This program grew out of the 1979 DoD Survey of Personnel Entering Military Service (Doering, Grissmer, & Morse, 1980) and the 1982 DA Survey of Personnel Entering the Army (Elig, Johnson, Gade, & Hertzbach, 1984). In the late 1980's, USAREC assumed responsibility for administering the NRS and analyzing the data.

Analyses of NRS data have been rather sporadically reported, and it is not known how extensively USAREC currently makes use of the data. ARI researchers Pliske, Elig, and Johnson (1986) reported analyses of 1982/1983 NRS data from AC recruits in which they examined a model of enlistment decision making. The Naval Postgraduate School (Gray, 1987) used 1985 AC NRS data to examine differences between high and low aptitude new recruits in enlistment motivations. High aptitude recruits were more likely to be influenced by bonuses, the two-year enlistment option, and educational benefits compared to lower aptitude recruits. Lower aptitude recruits were motivated by opportunities for skill training, earning more money, retirement, and fringe benefits. Similar findings were reported for female recruits.

There have been some published analyses of NRS data collected from RC recruits. An ARI researcher, Dale (1989), used NRS data collected from new RC recruits in 1982 to study attrition from the RC. This research was described in our Volume 1 report. Simple tabulations of RC NRS data collected in 1985 have been published (Westat, 1986a,b,c) and two reports of analyses of 1987 NRS data on RC recruits conducted for USAREC are also available (Gorman & Thomas, 1989; Schroyer, Gaskins, & Waters, 1988). Gorman and Thomas looked at data from 1,364 male and 397 female non-prior service USAR recruits. They found that high aptitude recruits were motivated more by money and job considerations, whereas lower aptitude recruits were motivated more by patriotism and family tradition. In another analysis of 1987 NRS data, Schroyer et al. compared enlistment motivations of AC, Guard, and Reserve recruits. Of these three groups, Army Reserve recruits were the most influenced by money for college. They also had the highest aptitude scores and educational goals. AC recruits were more highly interested in training opportunities than RC recruits.

Another relatively extensive ARI research effort to study youths' decision-making with regard to joining the military (both enlisted and officer corps) was the Army Communications Objectives Measurement Systems (ACOMS) survey program (e.g., Nieva, Gaertner, Elig, & Benedict, 1988). Data were collected via computer assisted telephone interviews from young people 16-24 years old during 1986-1987. Analyses conducted on these data explored a variety of areas, including brand differentiation among Army components and the other military services, media habits, recall of Army advertising, and career choice behaviors. For example, results showed that the USAR was relatively undifferentiated from the Army AC, whereas the ARNG was more clearly distinguishable to youth as a different career choice.

In another project conducted for USAREC, ARI studied the enlistment propensities of civilian registered nurses and nursing students (Ramsberger, Barnes, DiFazio, & Tiggle, 1994). The Army Nurse Corp is more than three-quarters RC officers, and adequately maintaining manpower levels is a constant challenge for recruiters. This research showed that propensity to serve was generally low, and survey respondents indicated that they would have been more inclined to join prior to Operations Desert Shield and Storm (ODS). Nurses with a relatively high propensity for the RC had a greater interest in research, desire to attend specialty courses, and had higher incomes compared to those with lower propensity to serve in the RC.

In 1995, AmerInd, Inc. conducted several studies of special enlisted populations within the USAR, including soldiers early in their obligation (i.e., less than 30 months since first drill). In this study, survey data were collected from a random sample of 147 reservists with less than 37 months as a member of a drill unit (AmerInd, Inc., 1996b). According to these respondents, the most important reason for enlisting was to gain GI bill benefits and another consistently important reason was to gain self-discipline. The "other" category was also heavily endorsed as being important. This category included responses such as the following: to learn a skill, adventure, to be proud. Almost half of the respondents reported receiving at least one signing bonus.

AmerInd, Inc. (1996a) also conducted a survey of physicians in the Reserve to examine recruiting and retention issues specific to this population of officers. A total of 835 physicians

responded to the survey. Almost half of the respondents had no military experience prior to their service in the USAR. The top rated reasons for joining the Reserve were service to country, professional satisfaction, and change of pace. Financial incentives were more influential among younger physicians than among the older physicians.

Previously, the OCAR had commissioned a study to examine enlistment motivations of recruits both before and after ODS (Griffith & Perry, 1993; Perry, Griffith, & White, 1991). Surveys were administered to representative samples of enlisted reservists in 1990 and 1991. Major considerations in the enlistment decision across both samples were wanting to experience the military, personal development, pay/benefits, and job/career development. Wanting to experience the military was a more important consideration after ODS than before, whereas the importance of personal development decreased.

The Naval Postgraduate School has also conducted a number of different studies looking at recruiting issues in the USAR. These studies have looked at issues such as recruiting females, using Youth Attitude Tracking Survey (YATS) data to examine propensity to join, effectiveness of enlistment incentives, impact of commuting distance on recruiting, and effects of population migration patterns on recruiting.

Other Military Research

The Office of the Assistant Secretary of Defense (OASD) has sponsored a number of efforts to assist the services with their recruiting efforts. OASD sponsors YATS, a periodic survey of a national sample of youth that monitors propensity to serve, as well as research that uses the YATS as its primary data source. In particular, Rand has published a number of analyses of YATS data that explore youths' decision-making processes with regard to career intentions (e.g., Orvis, Gahart, & Hosek, 1989). A couple of these studies have focused specifically on recruiting for the RC. OASD has also sponsored periodic surveys of AC and RC recruiters to gather data on difficulties they experience recruiting.

Recruiting for Voluntary Mobilizations

ARI research conducted to examine experiences associated with the use of RC personnel to support a rotation of the Multinational Force Observers (MFO) mission in the Sinai (Phelps & Farr, 1996) was described in our Volume 1 report. The research identified a number of ways in which the mobilization effort presented a significant challenge to the Army and to individual soldiers and officers. Although the mission was met, in terms of the numbers and quality of soldiers deployed, considerable effort was required to identify replacements for individuals who initially volunteered for the mission but then subsequently declined to participate. Presumably, the no-show problem could be reduced by examining more closely and alleviating the problems soldiers experienced during the mobilization process. The problems identified in ARI's MFO study were conflicting needs from family, job, and school. There was also evidence that inadequate communication with volunteers throughout the mobilization process contributed to the "no-show" phenomenon.

Although not specifically designed to examine recruiting problems, both the Guard and the Reserve have explored issues associated with a number of mobilization efforts. For example, AmerInd conducted a series of focus groups of Reserve participants in Operation Joint Endeavor. Their findings were very similar to the MFO results described above. The National Guard Bureau published an After Action Report for ODS (undated). It cited the need for refinement of federalization procedures as a key to improved mobilization processes, as there was considerable confusion regarding federalization status and requirements.

Research Questions

Several significant research questions can be drawn from our analysis of the current RC recruiting environment, the existing literature, and our interviews with RC and ARI personnel:

What strategies for recruiting RC enlisted personnel are most effective? A starting point would be to look to the more general literature (i.e., related to the AC and other services) on enlistment decision-making to take advantage of the considerable work that has been done to understand and model the enlistment decision (e.g., identifying critical influencers and decision criteria). Though the models might require adjustment to better reflect the elements associated with the decision to serve in the RC, the basic decision process should be similar.

Another potentially valuable line of research is to assess the impact of state-level initiatives for recruiting ARNG personnel. For example, at least two states have established tuition-free incentives for people who enlist in the ARNG. Documenting the procedures and assessing the effectiveness of such incentives would enhance the program in those states and facilitate similar programs in other states (COL Gilbert & COL Shelley, personal communication, December 17, 1996).

An efficient way for the RC to gain access to current and historical information about RC-related enlistment decision making would be to develop partnerships with USAREC to gain access to data currently being collected from new RC recruits. Such a partnership could also lead to inclusion of items on the NRS survey that would be of particular interest to the RC. A related strategy would be to facilitate collaboration between contract researchers who work for the OCAR and USAREC and ARI researchers, all of whom are trying to learn about related enlistment issues. Given DoD's clear interest in recruiting issues across the services, it is likely that OASD would be interested in supporting and participating in such collaborative efforts.

What strategies for recruiting officers, including those with specialized skills (e.g., physicians, engineers), are most effective? Historically, the process for routing officers into the RC from the traditional commissioning sources (i.e., Reserve Officer Training Corps (ROTC), Academy, Officer Training School) has meant that most officers must be recruited as they depart the AC or from the pool of individuals qualified for direct commissions (e.g., physicians, engineers). So research has focused, and should probably continue to focus, on these types of positions. As the AC downsizes, however, it may be that there will be a larger pool of high quality

ROTC officer candidates available to the RC. At a minimum, RC units should be encouraged to maintain close contacts with ROTC programs to assure access to newly available junior officers.

As discussed above, ARI has already conducted some research related to nurse recruiting and the OCAR has sponsored research on physicians. A next step here would be determine the extent to which the OCAR would support collaborative studies with ARI, and to determine priorities for which other special populations should be studied. At a minimum, the research efforts of the two organizations should be coordinated to avoid redundancy.

How can the Army improve recruiting success in locations with traditionally low propensity to serve (e.g., in urban areas)? This was an issue raised in several of our interviews with RC personnel, particularly the ARNG. It may be that NRS data could be used to explore this issue at a fairly general level. A more promising strategy, however, would be to try to identify natural experiments from which to draw conclusions about the effectiveness of various strategies. This would involve identifying RC units that are trying different strategies to recruit in "hard to reach" areas, and attempting to match them to comparable units not applying those strategies. Alternatively, a more qualitative case study approach should yield informative insights into what works and what does not.

Are there effective ways in which RC recruiting can be linked to AC recruiting and turnover? USAREC is responsible for recruiting for the AC and the USAR, but is not involved in ARNG recruiting activities. Even though AC and USAR recruiting are handled under the same command, however, there is little evidence that the two activities are well-integrated so that they maximize benefits for both components. And to the extent that the AC is downsized relative to the RC, it is incumbent on the RC (both the USAR and ARNG) to effectively draw from the decreasing pool of prior service individuals.

Explicit coordination and cooperation among the three components on enlisted recruiting matters would be beneficial for all, perhaps particularly the ARNG since there is currently no coordination with AC recruiting (COL Nelson, COL Sullivan, & COL Carpenter, personal communication, December 17, 1996). It is possible that offering research support would be a means of encouraging such collaboration. For example, review of recruiting processes and procedures and might identify points at which an AC recruiter should consider steering a candidate to the USAR or ARNG. Similarly, review of separation procedures might identify ways to increase coordination for RC service.

How can the Army reduce drop-outs from volunteer deployments? There seems to be a considerable amount of information available to address this problem, particularly if one includes information drawn from deployment experiences that are not necessarily voluntary. What may be of most use at this point is to consolidate issues identified in different studies and develop plans for implementing solutions. Much of this work would seem to be operational rather than research in nature. But, at a minimum, it would be valuable to provide support by gathering reactions to planned changes in procedures (e.g., through surveys of previously deployed personnel) and formally evaluating future mobilization efforts.

Retention/Turnover

The interviews we conducted with RC officers during the course of this project revealed significant concerns about retention issues. Although some turnover from military service is to be expected, continued extensive losses of trained personnel drains training resources and threatens readiness. Increased concerns about retention are grounded in a number of factors. These include (a) the nature and number of missions that RC personnel are being asked to support, (b) the possibility that the Guard will be losing combat positions through force restructuring, and (c) the uncertainty of downsizing. The concern with the first two factors is that reservists are saying "I didn't sign up for this."

Turnover research has a long history, producing a number of models that seek to explain organizational withdrawal behaviors (e.g., Mobley, 1977; Price & Mueller, 1981; Steers & Mowday, 1981). Most of these models incorporate variables related to attitudes about the job (usually job satisfaction) and perceived alternatives for other jobs. The focus of these models has been, at least implicitly, on civilian turnover from full time jobs.

Knapp (1993) and others have discussed the need to distinguish between civilian and military turnover, and between different types of military turnover. Military turnover in the AC can mean failure to fulfill one's contractual obligation (attrition) or it can mean the failure to reenlist. In the active military, the former problem is typically of greater concern than the latter. The need for distinguishing between active and reserve turnover also seems apparent (Hom, Katerberg, & Hulin, 1979). RC personnel are primarily part time rather than full time, and so the factors associated with the turnover decision may be different. Despite these conceptual distinctions, meta-analyses of the turnover literature have typically combined results drawn from military and civilian studies (e.g., Steel & Ovalle, 1984). If only because the turnover base rate is typically much higher for military nonreenlistment than for civilian turnover, direct comparisons of point-biserial correlations are not meaningful. Indeed, at least one study used structural equation modeling to show that whether data were gathered in military or civilian settings served as a moderator in the prediction of turnover (Hom, Caranikas-Walker, Prussia, & Griffeth, 1992). Thus, while civilian-based turnover research literature can and should be used to help in the study of military attrition and reenlistment behavior, it is not sufficient for understanding either the AC or RC military turnover environment.

AC Turnover Research

It has long been known that first-term attrition for enlisted personnel is most accurately predicted by educational status (e.g., Flyer, 1959, Laurence, 1993; McCloy, DiFazio, & Carter, 1993). This is true for both AC and RC personnel, and it is why high school diploma status is an important characteristic established in recruiting quotas. It is also a common finding that women are more likely to attrit than men.

LaRocco, Pugh and Gunderson (1977), Royle and Robertson (1980), Youngblood, Mobley, and Meglino (1983), Motowidlo and Lawton (1984), Farkas and Tetrick (1989), Knapp,

McCloy, and DiFazio (1993), and Steel (1996) have studied reenlistment behavior of active duty personnel primarily from a psychological perspective. Most of these studies have used job satisfaction as a primary predictor of turnover and have shown that job satisfaction is positively associated with the intention to reenlist and actual reenlistment behavior.

RC Turnover Research

There are a number of studies, conducted by ARI and others, of turnover behavior in the RC that have taken an econometric perspective (e.g., Dale, 1987, 1989; Grissmer, Burright, Doering, & Sachar, 1982). Most of this research is based on the moonlighting theory, developed by Shishko and Rosteker (1976), which posits that the decision to participate in a part time job is driven by an evaluation of the net monetary and nonmonetary benefits of doing so. The amount of variance in turnover typically accounted for in this research is often disappointingly low. Some of this research has focused on the effects of a single economic motivator: reenlistment bonuses. For example, Rand conducted a series of studies to examine the effects of bonuses on reenlistment behavior across all military reserve components (e.g., Grissmer et al., 1982). The 1978 reenlistment bonus test showed that bonuses did not greatly increase the number of persons who reenlisted, but they did help extend reenlistment terms and reduced subsequent attrition.

Although there are several psychologically-oriented models that have been proposed to explain turnover behavior, Hom and his colleagues selected a more general behavior prediction model in an attempt to explain turnover from the ARNG (Hom et al., 1979; Hom & Hulin, 1981; Miller, Katerberg, & Hulin, 1979). Fishbein and Ajzen (1975) theorized that behavior is a function of a person's attitude toward the behavior and how significant others regard the behavior. The research that shows that RC reenlistment behavior is heavily influenced by the views of employers and spouses suggests that this type of model is well-suited to the RC environment. Hom et al. collected data on ARNG reenlistment in the late 1970's and found general support for this model.

It seems clear that the most effective strategy for predicting reserve reenlistment will be to include both psychological (e.g., patriotism, job satisfaction) and economic variables relevant to this environment. For example, both Grissmer, Kirby, and Sze (1992) and Lakhani and Fugita (1993) analyzed data from the 1986 Reserve Components Survey of Enlisted Personnel to study reenlistment behavior. Grissmer et al. looked at service-related variables (e.g., component, term of enlistment), demographic characteristics (e.g., gender, age), and civilian job characteristics (e.g., net wage, supervisor's attitude toward service). In this sample of over 5,000 RC personnel, the lowest retention rates were in the National Guard and Marine Corps reserve. Factors associated with failure to reenlist included perceived supervisor and spouse attitudes toward the reserve; dissatisfaction with training, equipment, and morale of the unit; and lower paygrades. Lakhani and Fugita compared the moonlighting and a more psychologically-oriented "patriotism" models of reenlistment using data from the 1986 RC Survey. They found that spouse's attitude was an even stronger predictor of reenlistment than reserve earnings.

Examination of the reenlistment intentions of USAR reservists with less than 30 months in service showed that difficulties getting benefits (essentially paperwork problems) was a significant problem and that this was a factor in their intentions to reenlist (AmerInd, 1996b). Other issues included pay and quality and amount of training. The same researchers studied educational support specialists who complained of poor computer support, understaffing, and other problems that resulted in relatively poor support of USAR personnel seeking access to their educational benefits.

Steel (1996) examined the impact of alternative job availability (both real and perceived) on the reenlistment behaviors of Air Force RC personnel. Using both the objective and perceptual indices of job alternatives together provided greater understanding of the reenlistment decision than either used alone.

There have been other research studies that have examined specific elements of the reenlistment issue and/or special populations. For example, AmerInd (1996a) found that USAR physicians planning to leave before retirement most frequently cited (in order of frequency of mention) the financial impact of mobilization, civilian employment demands, family demands, potential for future mobilizations, and low pay as the primary reasons for wanting to leave. Those physicians who indicated that they intended to stay cited service to country, retirement benefits, and their overall Reserve experience as their primary reasons for wanting to stay. The sampled physicians indicated great interest in a Ready Reserve Mobilization Income Insurance program.

As discussed in more detail in Volume 1, Ramsberger and DiFazio (1994) found that Reserve/Guard registered nurses were concerned about downsizing, feelings about the Army, job satisfaction, and the possibility of serving in combat when considering their career intentions. In an earlier study conducted for USAREC, a survey of USAR nurses showed dissatisfaction with communication, paperwork inefficiency, annual training inflexibility, and limited training (Miller & Ashton, 1990). However, for the respondents in this study, benefits rather than leadership or other factors were the most important reason for remaining in the RC.

Research Questions

As a general comment, the turnover literature is plagued with studies that have failed to use the most appropriate multivariate statistical methods to analyze their data. For most civilian turnover, for example, event history analysis is the preferred method, though psychologists are only recently beginning to learn about and use it (Dickter, Roznowski, & Harrison, 1996; McCloy, 1993). How researchers handle turnover base rate information is also an important aspect of the analysis and interpretation of turnover data. Thus, it is important that any research examining RC turnover behavior be based on careful consideration of alternative analytic methods.

What factors are most highly related to retention, particularly for understaffed positions? There has been a great deal of work here that at this point needs to be integrated into a comprehensive RC-specific model of turnover behavior. Prior research has shown that this model should include variables such as spouse and employer support, job satisfaction, unit morale, satisfaction with

equipment and training, leadership factors, camaraderie, and administrative support issues. Of particular interest to RC personnel, based on our interviews, is a better understanding of how leadership and training influence retention. The consensus of opinion from those we spoke with is that intense training and utilization are good for retention. But there is also concern that putting too many requirements on members may make retention more of a problem. One officer, for example, recommended research to identify the "too much" line (COL D. Youngman, personal communication, December 12, 1996). A more comprehensive model would clarify the nature and magnitude of the roles of leadership and training on retention.

What strategies would help reduce turnover? Several researchers have already pointed out the need to implement policies to appeal to the concerns of employers and spouses in order to increase reenlistment (Grissmer et al., 1982; Lakhani & Fugita, 1993). The research clearly indicates their importance to the reenlistment decision, so the question now becomes to what extent can the Army influence their opinions. We would also suggest a more expansive approach initially, systematically identifying those factors influencing the retention decision over which the Army, through its policies and procedures, can have at least some influence. Administrative problems (e.g., poor record-keeping, training scheduling difficulties, delays in obtaining pay and benefits) cited in several pieces of research, for example, are certainly under the control of the Army. Resource constraints may lead to inattention to such details, but research that clearly demonstrates their impact on turnover may provide the necessary incentive to make such issues a higher operational priority.

What are the effects of providing realistic job information to prospects? There is some evidence that reservists are disappointed with their RC experience, which might make them more inclined to leave the service. Though providing prospects with realistic expectations (e.g., the RC is likely to take more time than it says on paper) may hurt recruiting efforts, the payoff could be in increased retention. It would seem worthwhile to explore the possibilities further by devising ways for recruiters to convey such information effectively and to evaluate the utility of doing so.

How can turnover be defined and tracked to facilitate turnover-related research and management? A perpetual problem in the study of turnover is the difficulty of measuring this seemingly objective variable. A typical problem is having involuntary turnover intentionally categorized as voluntary turnover (e.g., a poor performer agrees to leave when asked to do so). Turnover from the RC is complicated enough to suggest that some attention be paid to how different types of turnover are grouped for purposes of turnover research and management, and then assuring that personnel files maintain the required information accurately. There are many distinctions that might be made: officer versus enlisted attrition, continuation (staying from year to year), and reenlistment; leaving the service altogether or leaving for the IRR or another component; leaving early in one's career versus leaving later; separation of part time versus full time personnel. Greater attention to how researchers treat these different variations of RC "turnover" is bound to increase our ability to understand it.

Selection, Classification, and Performance Management

We found little evidence of RC-specific work conducted for the Army or any of the other services related to this research domain. A small exception was a study performed at the Naval Postgraduate School for USAREC on the selection of active Guard and Research recruiters (G. W. Thomas, 1987). Presumably this relative lack of research emphasis is because (a) related research conducted in the AC is typically generalizable to the RC and/or (b) the way that the RC has traditionally operated has made such research a relatively low priority, particularly compared to research needs in the training arena. But trends affecting the RC suggest some work in this area that would help the RC use its human resources more effectively in its future environment.

This is a relatively eclectic discussion section, in that we zero in on a diverse set of needs that were identified in this project as warranting research attention. Specifically, needs in four areas are reviewed: (a) selecting enlisted personnel with technical skills, (b) supporting reclassification requirements, (c) developing individual performance measures and standards, and (d) documenting unit administrator task requirements.

In addition to the topics discussed here, the reader is referred to a Joint-Service selection and classification research roadmap presented by J.P. Campbell et al. (1994). That report discusses critical research questions in the following areas: (a) building a Joint-Service policy and forecasting database, (b) developing new job analysis methodologies, (c) capturing criterion (job performance measurement) policy, (d) conducting criterion measurement research, (e) conducting predictor-related research, (f) modeling classification decisions, and (g) investigating test fairness issues. Although some of the research questions are more relevant to the AC than to the RC, this research agenda was developed for the total Joint-Service force.

Selecting Enlisted Personnel with Technical Skills

Force downsizing and restructuring activities can have significant implications for the ways in which personnel are selected, classified, and utilized. One scenario raised in several of the project interviews was the possibility of selecting for certain skills rather than training for those skills. This strategy, if proven feasible, would allow increasingly limited Army training resources to be focused on skills specific to the Army.

The feasibility of this strategy rests most fundamentally on the availability of applicable training outside the military. The military is already accustomed to accepting the education and civilian credentialing of physicians, nurses, engineers, and selected other professional skills required of its officers. And in the USAR, in which most enlisted positions are combat service support, there are many required job skills that can be obtained outside the military (e.g., truck driving, medical support). Various civilian credentialing programs document competence in some of these skills, but not in others. In the ARNG as it is currently structured, most positions are combat and combat support, making this option, for the time being at least, not as feasible.

The idea of recruiting enlisted personnel with the requisite technical job skills and bringing them in at upper grade levels (E5 or higher) was raised in interviews with both USAR and ARNG personnel. They were interested in the potential for saving precious training resources and reducing skill decay by accessing people who perform similar work in their civilian jobs. Nevertheless, there will likely be institutional resistance to this type of change to the personnel management system. Technical training, both for initial MOS classification and for reclassification requirements (see below), is currently governed by a relatively lock-step Total Army School system. Speeding up training and/or reducing training requirements would be a mixed blessing for this system.

Research Questions

For which MOS could technical skills be selected for rather than trained? Although there may be several other factors that determine the feasibility of selecting for certain skills rather than training them, perhaps the most fundamental question is which MOS have enough overlap with civilian skills to make this an option worth considering further? One strategy would be to identify possible MOS at a fairly global level (e.g., based on job titles). A crosswalk of military to civilian occupations developed for DoD (Wright, 1984) would be helpful for this level of inquiry. Of course, most combat positions would have to be eliminated early on, as they are unlikely to have close civilian counterparts. The next step would be to use more detailed occupational analysis information to identify the nature and number of skills required by an MOS that appear to be covered in civilian education, training, or job opportunities.

For selected MOS, how could knowledge and skill acquisition be confirmed prior to selection? There are several options that might be available to the Army in determining whether an individual has sufficient knowledge and skill to do the technical work required in some MOS. The easiest strategy would be to identify civilian educational, licensure, and/or certification credentials that would provide sufficient evidence of knowledge/skill acquisition. In this way, the Army could take advantage of the ever increasing numbers of certification programs for "nonprofessional" occupations that are available in the civilian sector. Another strategy would be to accredit civilian training programs to assure that they meet the Army's needs, then accept successful completion of such programs as evidence of skill acquisition. If these strategies are not sufficient, tests could be developed that individuals would have to pass before being selected for certain MOS. Such certification tests would be the most direct demonstration of the nature and level of competence required by the Army. They would also have potential as recruiting and counseling tools.

Supporting Reclassification

In the AC, classification of enlisted personnel is a critical decision point for which a great deal of research has been performed (e.g., J.P. Campbell & Zook, 1995). In the RC, however, classification is handled much differently. To the extent possible, classification is based on an individual's prior service MOS because this minimizes training requirements to reach MOSQ. In the ARNG, designation of the unit to which an individual is joining (e.g., infantry, armor) will

largely determine MOS assignment. Indeed, a relatively common occurrence is for a unit's designation to change, resulting in the need to reclassify and therefore retrain individual reservists.

Whatever the specific method for classification or reclassification, explicit consideration of an individual's aptitude and qualifications is not a significant part of the RC equation as it is with the AC. But ARI research could support the RC in the reclassification arena by looking for any "MOS-specific" job requirements that overlap across selected MOS. The idea is that commonalties across MOS (e.g., between 11B-infantry and 13B-cannon crewmember) could be used to reduce the retraining requirement when reservists are reclassified.

Research Questions

For selected MOS, what, if any, technical skill requirements overlap? The first step here would be to identify MOS which have the highest likelihood of being affected by large-scale reclassification (e.g., of several units) and select a small number (two to three) to test this concept. The next step would be to examine information about job requirements to identify what, if any, redundancies exist. Common soldiering tasks would be easy to identify as they are identified through doctrine. The search for other commonalties will be complicated by the probability that there will be little overlap in tasks (other than those that are common across all MOS). Rather, it is more likely that underlying skills (e.g., troubleshooting, record-keeping) will show redundancy that could then be exploited through modified training programs. It is relatively easy to obtain lists of MOS tasks, but the knowledge and skill requirements underlying the ability to perform those tasks may need to be identified before this research goal could be achieved.

What savings are achieved through reduced reclassification training? If there are any training resources saved as a result of systematic efforts to identify knowledge/skill redundancy across various MOS, the next question will be whether the savings offset the costs of identifying these redundancies. This will require an assessment of the costs associated with the identified methodology and the savings achieved through redesigned, presumably more abbreviated, retraining activities.

Individual Performance Measures and Standards

Group level performance measurement was discussed previously in the context of training. In this section, we want to raise the importance of individual performance measurement. Assessment at the individual level can serve a variety of purposes, including (a) criterion measurement in selection and classification research, (b) measurement of individual skill acquisition to determine MOSQ and/or provide developmental feedback, and (c) support for force integration planning and research.

ARI has conducted a great deal of research in the area of individual performance measurement, primarily for its use as a criterion measure. Indeed, through the Project A research

program, the Army has led academia and industry in making scientific and practical strides in this area. Though mostly based on work with AC personnel, this research is generalizable to the RC. Standardized hands-on and written tests of task knowledge and skill and rating instruments suitable for peers and supervisors have been developed for the MOS listed in Table 8. These measures cover both MOS-specific and common soldiering skills. Though they may require updating and/or tailoring, these measures, and the procedures for developing them, are available to the RC for test validation or training and development needs.

The Project A work successfully demonstrated that performance on the Armed Services Vocational Aptitude Battery (ASVAB) and other experimental selection and classification measures was correlated with performance on a variety of job performance measures. This work helped illustrate that performance is multidimensional and that there are a variety of ways to assess various elements of performance (e.g., technical skill proficiency, leadership), none of which is flawless. Rather, a "whole-person" view of performance is best achieved through the use of multiple measurement methods to assess success in both "can-do" and "will-do" aspects of performance.

Table 8.

MOS with Project A-Developed Job Performance Measures.

11B	Infantryman
13B	Cannon Crewmember
19E/K	Tank Crewmember
31C	Single Channel Radio Operator
63B	Light Wheeled Vehicle Mechanic
71L	Administrative Clerk
88M	Truck Driver
91A/B	Medical Specialist
95B	Military Police

But Project A researchers did not have to establish performance standards on either the new predictor tests or the job performance tests that they developed. Training programs, on the other hand, must set performance standards to assure that trainees have reached MOSQ before they are allowed to leave training. And if efforts proceed to enlist individuals who have demonstrated sufficient skill in particular areas, standards will have to be set for the tests used to certify those skills. Force integration policy and research is another area in which the issue of performance standards must be addressed. Force integration was a topic that frequently surfaced during our project interviews, and it is one that is fraught with sensitivity because it raises the

question of whether RC personnel are trained well enough to work effectively with AC personnel.

Research Questions

What types of individual performance standards do Army researchers, trainers, and policy-makers need? This is clearly a question that should be posed with an eye toward both AC and RC personnel simultaneously, and a good example is MOSQ. Interviews with RC leaders showed a strong desire for alternatives to course completion to determine whether a soldier in a given MOS is qualified to serve in that MOS. For some purposes, it may be sensible to have more than one standard. One level of performance might be acceptable for training environments whereas another higher level might be required for more demanding environments or for higher ranking soldiers. It is conceivable, but probably not politically palatable, to have different minimum standards for RC and AC personnel, given the higher expectations of soldiers who are training full-time rather than part-time. In any case, the point here is to do some kind of needs analysis to determine where systematic procedures for establishing standards are required or would improve upon current strategies.

What standard setting methodologies would be most useful for helping to set Army individual performance standards? There are strategies for establishing performance standards for selection and certification tests that could be adapted to the determination of job performance standards (Angoff, 1971; Livingston & Zieky, 1982). The so-called criterion-referenced strategies generally involve the collection of expert judgments from a sample of carefully selected judges. There are more empirical strategies that are not often feasible to apply, but which might be quite appropriate for the military environment.

Documenting Unit Administrator Task Requirements

A specific issue raised by some interviewees was the amount of undocumented work that unit administrative personnel put in to make an RC unit work. The concern is that units cannot be successful unless unit administrators are willing to work longer hours than prescribed, and that this problem will only get worse as downsizing takes its toll on the availability and responsibilities of administrative personnel. RC personnel we spoke with wanted documentation of the broad responsibilities of this key position to help defend against efforts to reduce their administrative resources. It may be, however, that this question should be framed more broadly, at least initially. That is, it may be that there are other positions or certain MOS for which RC-specific job description information would be useful.

Research Questions

What positions require RC-specific analysis? Inquiry regarding existing task analysis information and targeted questions to the RC about any other positions would help identify positions other than unit administrator that merit analysis. The goal would be to look for positions that have no analog in the AC or for which unique RC requirements may make separate

RC analysis necessary. In some cases, it may be that the occupational analysis researchers already have required data that just need to be packaged for use by users outside of TRADOC. Note that the Air Force has conducted some research looking at occupational analysis strategies across AC, RC, and civilian positions that might offer some insight in this area.

What are the responsibilities of an RC unit administrator? This could be a fairly traditional task analysis that identifies tasks performed in this position and collects data on task importance and time spent using a survey-based methodology.

Management Systems

This section briefly discusses issues of a more operational nature than those discussed in other sections. These are issues that will likely involve the use of technology (i.e., automation) or organizational reengineering to address and, although ARI is not a software developer or organizational change consultant, it can provide design and evaluation research services that would assist in these areas.

Many of the problems identified in ARI and other surveys of RC personnel attitudes related to training and deployments are founded in administrative problems. Lack of communication, poor record-keeping, limited access to equipment, and generally poor orchestration of large-scale activities (most notably the ODS call-up) were all cited as significant problems in multiple surveys. And it is these types of problems that have been shown to decrease retention rates, a problem that may increase as more technologically savvy recruits quickly become frustrated with administrative and training problems that they consider easily surmountable with automation.

Several RC personnel we interviewed were also concerned about the inefficiencies and other problems associated with the decentralized way in which assignments and promotions are made in the RC. For example, it is believed that well-trained personnel are unnecessarily lost to the RC when they relocate because there is no formal mechanism for trying to place the relocated individual into a unit near his or her new home. There is also considerable concern that personnel "game" the system, moving from one unit to another to get promotions. With more centralized information systems, it might be possible to make assignments and promotions in ways that benefit the needs of the RC, RC units, and individual soldiers and officers. Such systems, assuming that they can be practically applied, would increase the fairness of promotions and assignments, reduce the need for retraining, and increase readiness by more effective person-position matching.

In an effort to address many of the concerns that have been raised by USAR personnel, the Army Reserve Personnel Command (ARPERSCOM) is involved in a major reorganization. Personnel from ARPERSCOM who were interviewed in this project expressed interest in an evaluation of the effectiveness of their reform efforts. Such an evaluation may be within the scope of ARI's research mission.

Research Questions

How can training and deployment activities be more effectively orchestrated? What might be useful here is to consolidate the information from previous research that documents the magnitude and impact of problems in these areas. Such documentation may be required to help acquire the resources necessary to address the problems. It would also be useful to look for related problems that could be addressed with common solutions (e.g., a more manageable, up-to-date personnel database accessible to all with a need to know). A less expansive strategy would be to cull from existing work the information needed to identify and address problems in specific areas (e.g., pay, access to educational benefits). An example of this more focused strategy is research to improve the compatibility between the AC SIDPERS and the RC SIDPERS. The systems will not be fully compatible until DoD adopts a standard personnel system. (Kentucky, for example, is scheduled to be on-line in 2001.) In the interim, research to develop bridge procedures would be welcome (COL Smith, personal communication, December 17, 1996).

Can some aspects of assignments and promotions be effectively centralized? The key here seems to be identifying a strategy that would solve more problems than it creates. So it would make sense to learn more about the current system. How does it work in a "typical" unit. Are there formal or informal links between assignment and promotion decisions across units in the same or different geographical areas? What works and what does not with the current system? As the current system is better understood, it might make sense to start small, introducing small changes to increase communication about unit needs and available personnel. More formal requirements to centralize (at some level above the unit) assignments and promotions, if they show promise, could be introduced perhaps on a pilot basis in one region or another and evaluated before larger scale changes are made across the component (USAR or ARNG).

Are ARPERSCOM efforts to reorganize improving organizational mission effectiveness? As with any evaluation study, it will be critical to identify what (e.g., pay delivery, timeliness of paperwork) is expected to improve with the reorganized ARPERSCOM and to identify or develop reliable and valid measures of those variables. It is also important to establish baseline measures for these variables prior to implementation of the reorganization effort. Accordingly, if the reorganization is going to be evaluated, the process should start as soon as possible to allow for this. It is very possible that available survey data will be one important source of such baseline information.

Leadership

The central role leadership plays in the effective functioning of the military has long been understood. The Army has sponsored a significant amount of research in the study of leadership, and offers formal training for leaders (e.g., US Army War College, CAS[3], US Sergeants Major Academy) as they step into critical leadership levels.

In this environment of uncertainty in the military, the key role of leadership becomes, if it is possible, even more critical. And for the RC, which is taking ever greater responsibility and

accounting for greater proportions of the Army's total force, the days of taking the leadership skills of its officers and senior NCOs as a given are over. The increasing demands of the RC will be most effectively met if its leaders are given additional tools and training.

As discussed in the critical questions listed below, we believe that leadership issues should be addressed in at least three ways: (a) identifying the characteristics that lead to success as an RC leader, (b) developing training and development tools that will help RC leaders improve their leadership skills, and (c) looking at the impact of leader attitudes on Army goals, most particularly in the goal to develop a fully integrated total force.

We interviewed a TAG who estimated that the ARNG loses 50% of its new officers within two years of joining the RC (MG Kane, personal communication, January 12, 1997). We interviewed other RC personnel and researchers who speculated that someone who has been a good leader in the AC will not necessarily be particularly successful as a leader in the RC. A key difference may be in the need for flexibility demanded of an environment in which schedules, equipment, and so forth cannot be as tightly controlled as they can be in the AC.

The general leadership literature supports the notion that there are common characteristics of effective leaders, but that different situations may demand somewhat different leadership styles. The Army has leadership doctrine, as set forth in Field Manual 22-100, that specifies leadership requirements in the Army environment. But the question to be asked is, are there some characteristics that become more or less important to successful leadership in the RC environment? The information gained from this type of research could serve as the foundation for RC-specific leadership courses and development tools. It might also eventually be used to help identify those ROTC or prior service officers with the greatest potential for success in the RC.

ARI, U.S. Army War College (USAWC) and IDA researchers are working on 360-degree rating instruments to provide feedback to leaders for development purposes (e.g., S. Halpin, personal communication, June 19, 1996; Jacobs, undated). The Strategic Leader Development Inventory (SLDI) is designed for senior officers and is used for students at the USAWC and the Industrial College of the Armed Forces. The Azimuth Check is an adaptation of the SLDI developed by ARI to be suitable for all officer ranks. It is currently being administered to Captains attending the CAS^3 course at Ft. Leavenworth. Plans are to computerize this instrument and make it available for field commanders for their own self-development activities. ARI is also working on computerization of a command climate survey that will be made available to field commanders by the fall of 1997. These and other efforts can help both AC and RC leaders work on their leadership skills without taking the time and expense of attending off-site courses.

Our interviews with RC personnel revealed considerable frustration with the difficulties associated with trying to be truly integrated with the AC as envisioned by the total force concept. Of particular concern is the perception that AC leaders, even at the highest levels, do not really believe that the RC will ever be able to handle the role it has been given, and that this belief trickles down through all levels, making successful integration on a large scale virtually impossible. Clearly, this is a sensitive issue. But if these are common perceptions, then a focus on officer attitudes is required before real, long-term integration will be possible. The Army has

faced this type of situation with racial integration and increased use of women in the force. It may be that successful integration of RC and AC personnel will require similar measures.

Research Questions

What characteristics make leaders successful in the RC environment? There are a variety of ways that this question might be asked, and strategies that avoid explicit measurement of success of individual leaders will likely be the most feasible to pursue. Critical incident analysis, using incidents drawn from the AC and the RC would be one nonthreatening way to identify and document differences both in the types of problems encountered and the behaviors required to handle them. The OCAR has sponsored research on effective leadership behavior in the USAR (e.g., K. Thomas & Barrios-Choplin, 1996) that should also be incorporated into future studies. In addition to documenting the importance of leader behaviors with regard to such areas as time commitment to the unit, managing unit training, and improving standards, this research has identified concrete best practices and pointed out two common leadership problems (micromanagement and use of punishment).

What tools are useful for leadership development in the field? We suggest continued support of work related to the SLDI and Azimuth Check, with explicit emphasis on special needs, if any, of using these instruments with RC personnel. Some of our interviewees and K. Thomas and Barrios-Choplin (1996) also called for increased mentoring opportunities as a promising avenue for leader development. Another suggestion would be to provide leaders with easily digestible quantities of training and information online. Training-oriented pieces would focus on case studies, common leader errors, and so forth, while information-oriented pieces would focus on research findings and other information that can help leaders perform their jobs. Such special topic reports related to ARI research findings are currently being developed.

What is the extent and impact of component biases among AC and RC leaders? We have included this research question because it appears to be an important one to the success of the total force, not because it would be a welcome research topic in the eyes of Army leaders. Indeed, this may be an area in which quantitative research will be less useful than qualitative research (e.g., case studies, interviews, critical incident analyses). As with other issues we have mentioned, the first step is to document the problem. The second step is to then incorporate content directed at this issue into training programs, increase opportunities for collaboration at all levels of the AC and RC, and possibly initiate programs ala diversity training exercises.

OVERALL AGENDA

The critical research questions posed within each research domain discussed in this report are listed in Table 9. As discussed in the introduction, it was difficult to obtain specific guidance from either ARI researchers or RC leaders regarding which research domains deserved the most attention, let alone the relative priority of individual research issues that cut across those domains. What we have done, however, is attempt to capture overall impressions drawn from the researchers and leaders interviewed for this project and merge these with our knowledge of ARI research programs to

Table 9.

Summary of Critical Research Questions

Domain	Area	Question
TADSS-Based Training	Cost Effectiveness Trade-Offs	How effective is a given TADSS in the RC environment? What savings associated with TADSS-based training should be expected? Can performance categories be identified for which alternative TADSS designs are most effective?
	Part-Task Training	How should a task be segmented for part-task training? What is the optimum mix of part- and whole-task devices?
	TADSS Fidelity Requirements	How should secondary fidelity criteria be combined to predict transfer? What measures should be applied for each fidelity attribute? What methods should be applied to improve the quality of secondary fidelity criteria? How do soldiers' reactions to low fidelity TADSS impact on the true importance of fidelity? How accurate are predictions by a transfer prediction model?
	Training Support	What content should be developed for TADSS training? How well do TSPs support implementation of TADSS training in the RC environment?
	Computer-Generated Forces (CGF)	Are computer-generated OPFOR justified? How should requirements and parameters for CGF be established? How are performance and training effectiveness affected by simplifications in the representation of CGF?
	Micro-Level Strategies	How should TADSS-based training be implemented in the RC environment? What learning variables promote skill acquisition, retention, and transfer?
Performance Measurement	Diagnostic Measures	What level of detail is needed for diagnostic instruments?

	Proficiency Assessment	How should performance assessment measurement systems be structured? What is the reliability and validity of MOE?
Training Management	Macro-Level Training Strategies	What tasks should be trained in TADSS-based and field events during an RC unit's training cycle? How does the basis of issue of TADSS affect the macro-level strategy for RC units?
	Database Development and Maintenance	What interventions or interruptions have an impact on unit performance? How can the armor/mechanized infantry database be maintained and accessed? How should variables be aggregated for a collective training database?
Distance Training	Distance Learning (DL)	What is the most cost-effective combination of media in DL? What types of interactivity are required in DL? What skills are required for instructors to be effective in DL? What savings can be anticipated from DL?
	Distributed Interactive Simulations (DIS)	What savings can be achieved by conducting collective training in a DIS mode? How can tactical engagement simulation systems be integrated to support training in a DIS mode?
Additional Areas for Training Research		What are the effective training delivery techniques? What is the training delivery capability of the Internet? Are there alternative evaluation models?
Recruiting		What strategies for recruiting enlisted personnel are most effective? What strategies for recruiting officers, including those with specialized skills (e.g., physicians, engineers) are most effective? How can the Army improve recruiting success in locations with traditionally low propensity to serve (e.g., in urban areas)? Are there effective ways in which RC recruiting can be linked to AC recruiting and turnover? How can the Army reduce drop-outs from volunteer deployments?

Retention/Turnover		What factors are most highly related to retention, particularly for understaffed positions? What strategies would help reduce turnover? What are the effects of providing realistic job information to prospects? How can turnover be defined and tracked to facilitate turnover-related research and management?
Selection, Classification, and Performance Management	Selecting Enlisted Personnel with Technical Skills	For which MOS could technical skills be selected for rather than trained? For selected MOS, how could knowledge and skill acquisition be confirmed prior to selection?
	Supporting Reclassification	For selected MOS, what, if any, technical skill requirements overlap? What savings are achieved through reduced reclassification training?
	Individual Performance Measures and Standards	What types of individual performance standards do Army researchers, trainers, and policy-makers need? What standard setting methodologies would be most useful for helping to set Army individual performance standards?
	Documenting Unit Administrator Task Requirements	What positions require RC-specific analysis? What are the responsibilities of an RC unit administrator?
Management Systems		How can training and deployment activities be more effectively orchestrated? Can some aspects of assignments and promotions be effectively centralized? Are ARPERSCOM efforts to reorganize improving organizational mission effectiveness?
Leadership		What characteristics make leaders successful in the RC environment? What tools are useful for leadership development in the field? What is the extent and impact of component biases among AC and RC leaders?

generate some ideas regarding RC-related research priorities. What follows in this section, then, is a research agenda that ARI can use to help define its research programs in the coming years.

General Research Priorities

The critical research questions identified in this report, by design, relate to research areas that are either within the scope of ARI's current or recent research programs or are compatible with those programs and the research and consulting expertise they represent. Table 10 depicts how these questions relate to ARI's recent, current, and future research agendas. The rows in Table 10 list the research domains, and the areas encompassed by each. The first two columns indicate which areas have been addressed with significant amounts of past, present, and future ARI research. The first column identifies areas that have had a relatively heavy explicit focus on the RC whereas the second column identifies areas for which ARI has conducted relevant research on the AC, with relatively little specific emphasis on the RC. The identified areas in these columns could be considered the "core business" of ARI's research because the findings of this project suggest that ARI work in these research areas should continue.

The last column in Table 10 indicates the areas that are in need of RC-specific research attention in the immediate and longer-term future. Every research area is marked, reflecting the fact that there are RC-relevant research needs in each. The column includes ARI's "core business" areas that have previously been targeted toward the RC (e.g., training support, DL), core areas that have previously been focused primarily on the AC (e.g., TADSS-based fidelity, recruiting), and areas that represent a bit of a departure from ARI's previous research programs (e.g., management systems). We have assigned rough priorities to the different areas as discussed below.

The areas related to training that have previously enjoyed ARI research support, we believe, should continue to get the highest priority in ARI's future RC-related research agenda. This includes areas, such as TADSS cost effectiveness tradeoffs, that can continue to have a broad research focus (i.e., RC-specific research is not required), but which likely have a higher research priority for the RC than the AC because the RC has more limited training resources. Both the broader and RC-specific efforts (e.g., on DL and TADSS strategies) are vital for maintaining a close relationship with RC units and leadership. Indeed, one of the RC leaders we interviewed who deals with TADSS-based training concluded his interview with the comment: "ARI has a real role to play. If ARI does not provide. . .information, where will I get it?" (COL R. Krug, personal communication, December 12, 1996). Such positive relationships with units and leaders will keep ARI expertise on the RC environment current and visible.

Several of the non-training research areas marked in the last column of Table 10 have been examined in ARI research that has not previously had a strong explicit RC focus, but for which RC-specific work is needed. For example, research techniques developed to study retention and turnover in the AC could be readily adapted for similar questions in the RC. These areas should be moderate to high priority in ARI's research agenda for several reasons. For

Table 10

ARI Research Agendas

Domain	Area	Recent/Current RC Focus	Recent/Current Broad Focus	Future
TADSS-Based Training	Cost Effectiveness Tradeoffs		X	1*
	Part-Task Training		X	1*
	TADSS-Based Fidelity		X	1*
	Computer-Generated Forces			3
	Training Support	X		1
	Strategy	X		1
	New instructional techniques and research strategies			2
Performance Measurement	Diagnostic Measures		X	1*
	Proficiency Assessment		X	1*
Training Management	Macro-Level Training Strategy		X	1
	Database Development and Maintenance	X		1
Distance Training	Distance Learning	X		1
	Distributed Interactive Simulation	X		1
Recruiting			X	2
Retention/Turnover			X	2
Selection, Classification, and Performance Management	Selecting Enlisted Personnel with Technical Skills			2
	Supporting Reclassification			2
	Individual Performance Measures and Standards		X	2*
	Documenting Unit Administrator Task Requirements			3
Management Systems				3
Leadership			X	2

Note. Entries marked with an asterisk refer to research that may be conducted with the AC and still be applicable to RC needs. Numbers reflect rough research priorities.

example, capitalizing on AC prototypes (e.g., adapting the CATS calendar to the RC) will reduce the scope of projects and provide a high expectation of success. Also, work that has a broader relevance is likely to make greatest use of prior research findings and has a higher potential payoff than work that is only relevant to one component or the other. This includes considering what research may be applicable to both the USAR and the ARNG, but not necessarily the AC.

The lowest priority areas in the last column of Table 10 are those that begin to move beyond ARI's current core business areas. These areas represent needs identified by interviewees and that are well within the capability that ARI has demonstrated. While these research areas, as a group have the lowest priority, any of these areas might be given high priority by RC leaders. If that happens, ARI is well positioned in terms of staff expertise to add the area to its research program.

Other Issues Related to Research Priorities

There are several other key issues to be considered in determining specific research priorities. Perhaps most importantly is the issue of resources. ARI is experiencing large cuts in personnel and research dollars that must be reconciled with Army manpower, personnel, and training research needs. Clearly, not all research needs can be fully addressed in such an environment. Making the most of current resources combined with leveraging research that has demonstrated cost-savings to the Army to obtain additional resources in the future are critical tasks for ARI.

Another issue related to priorities is the extent to which applicable research is being conducted elsewhere (e.g., under the sponsorship of DoD or one of the other Services). Coordinating with related research programs to reduce costs for all could be an important strategy for addressing some Army RC research needs. Such a strategy could allow ARI to stretch resources to address some areas of research that it could not otherwise include in its research program.

Looking for underlying links across research areas is one more key to determining research priorities. For example, work with the recruiting and retention/turnover domains also offers opportunities for expanding RC support for ARI research. Almost all leaders interviewed considered RC manning to be a major problem, but there was also a sense that manning was largely a function of the quality of TADSS (which was thought to affect recruiting) and quality of training, options for MOSQ, and quality of leadership (which were thought to affect retention/turnover). In addition to addressing questions related to manning directly, it would be desirable to treat recruiting, retention, and turnover as criterion measures for assessing the impact of the other research areas.

SUMMARY

In this final section we offer several suggestions in an effort to assist ARI in using the results of this project to help meet the research needs of the RC. These suggestions involve (a) communications with sponsors, (b) interfaces with other research organizations, (c) using this research agenda as a starting point, and (d) following up on the ideas discussed in and generated by this piece of work.

Communications with Sponsors

It is critical that ARI establish and maintain two-way communications with its current and potential research sponsors. There is already a well-established relationship with ARNG training elements, but relationships with other ARNG interests and the USAR need to be developed and nurtured. Indeed, the USAR personnel we interviewed had only limited familiarity with ARI, and had little idea of how to approach ARI about their research needs.

Interfaces with Other Research Organizations

By establishing interfaces with the other Services and selected research institutions (e.g., IDA, Rand, AmerInd) who are engaged in related work, ARI can become a leader in fostering the coordination and sharing of RC-related research programs and findings. One strategy would be to sponsor a forum for sharing ideas and research. This could be done electronically via, for example, an Internet bulletin board or through periodic conferences. Conferences have some benefits, particularly in terms of providing the opportunity for face-to-face exchanges, but may not be practical in terms of travel budgets and the resources required to maintain the quality of papers. Bulletin boards, if informative and well-maintained, would likely achieve many of the same benefits in a more cost-effective manner. Yet another strategy is to explore Joint Service or DoD funding of research of interest across one or more of the Services. This strategy has been successfully used in the past (e.g., the Joint-Service classification research roadmap) and helps to assuage those who are argue that the Services approach research problems too unilaterally. On a related note, RC research should be explicitly considered in the development of Joint-Service research initiatives as defined by the TABSTEM group.

A Starting Point

The research agenda discussed in this report should be viewed as a starting point rather than an inflexible prescription for future research. It should be expected to evolve as issues and resources change over time, and close lines of communication with research sponsors will help to assure this evolution takes place. Moreover, it will be left to ARI and its sponsors to draw from the suggestions provided herein and, combined with their understanding of resource constraints and additional relevant information (e.g., leader priorities, Congressionally-imposed requirements), to translate this research agenda into a specific plan of action for ARI.

Follow-Up

The two volumes produced by this project will not accomplish anything in and of themselves. Both ARI and RC readers need to take responsibility for discussing their ideas and reactions to this work with those who will be responsible for obtaining and obligating ARI research resources in the future.

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APPENDIX A

PROJECT INTERVIEWS

Tables A-1 and A-2 provide a summary of the individuals who participated in project interviews. Our goal was to interview researchers and RC personnel representing a variety of perspectives, including those most familiar with training, manpower, or personnel issues and individuals at higher levels who are responsible for research and operations that span all of these areas. Table A-1 lists the RC personnel from both the USAR and the ARNG who were included in the interviews. Current and former ARI researchers were interviewed, as well as a small number of knowledgeable researchers from other organizations. They are listed in Table A-2.

At least one of the two senior researchers on this project participated in each interview. Responsible ARI researchers participated in many of the interviews as well. This was particularly desirable because the interviews served as a valuable ARI marketing initiative in and of themselves. That is, the face-to-face contact with a variety of current and potential clients was an important step in expanding and nurturing ARI's contact with the RC part of its user community.

The interviews were semi-structured. We introduced all interviewees to the project by describing to them the project goals, the approach, and the purpose of the interviews. We then asked interviewees to discuss trends affecting the RC and to describe research areas that they believe to be high priority for the current and future RC. Interviewees were also asked to provide any documents or other materials that might be useful to us in the development of an RC research roadmap.

Table A-1

Summary of Project Interviews with RC Personnel

Date	Interviewee(s)	Representing
1 Nov 96	BG Helmly, COL Guild, LTC Joel, COL McCloskey, MAJ Egbert, Ms. Kelly, LTC Lerch	Office of the Chief of Staff of the Army Reserve (OCAR); Personnel, Budget, Strategic Analysis, PAE
18 Nov 96	MAJ Egbert	OCAR, Office of Strategic Analysis & Liaison
18 Nov 96	LTC Fields, MAJ Ford	OCAR, Training
26 Nov 96	LTC Joel, MAJ Meyer, LTC Westmoreland	OCAR, Personnel
28 Oct 96	COL Squier	Chief of Staff
12 Nov 96	LTC Martinez, CPT Boston	NGB, Army Research Office; S1 of deployed unit
18 Nov 96	COL Himle, LTC Otto	NGB, Training, Training Support
12 Dec 96	COL Youngman, LTC Myers	NGB; KY ARNG, Brigade Commander and NGB Research and Staff Support Office
12 Dec 96	COL Krug	Advanced Research Projects Agency, Information Systems Office Program Manager
17 Dec 96	BG Groves, COL Smith, COL Jones, Mr. Barker	KY ARNG: The Adjutant General, Chief of Staff, US Property Fiscal Officer, Dept. of Military Affairs
17 Dec 96	COL Nelson, COL Sullivan, COL Carpenter	KY ARNG: Senior Army Advisor; Inspector General; Plans, Operations, and Training
17 Dec 96	COL Gilbert, COL Shelley	KY ARNG: Surface Maintenance, Command Logistics
17 Dec 96	LTC Sebastian, LTC Waggoner, LTC Storm	KY ARNG: Human Resources, Recruiting & Retention, Personnel
17 Dec 96	LTC Hetzel	KY ARNG: Director of Information Management
17 Dec 96	LTC Fincham, LTC Wadley	KY ARNG: Construction Facilities Management, Safety and Occupational Health
7 Feb 97	COL Gordon	ID ARNG: Senior AC Advisor
7 Feb 97	COL La Frenz	ID ARNG: Commander, 116th Calvary Brigade
7 Feb 97	MG Kane	ID ARNG: The Adjutant General

Table A-2

Summary of Project Interviews with Researchers

Date	Interviewee(s)	Representing
8 Oct 96	Drs. Gade, Seidel, Rumsey, Peterson, Drillings	Personnel Resources, Training, Selection & Assignment, Surveys, Basic Research
17 Oct 96	Dr. Michael Rumsey	Selection & Assignment
17 Oct 96	Dr. Alma Steinberg	Trend Analysis
23 Oct 96	Dr. Mike Sanders	Special Operations Forces
24 Oct 96	Dr. Trueman Tremble	Leadership
25 Oct 96	Dr. Robert Seidel	Training
25 Oct 96	Dr. Darrell Wostine	Occupational Analysis
15 Nov 96	Dr. Robert Sulzen	Training
18 Nov 96	Dr. Scott Graham	Training (Infantry)
22 Nov 96	Dr. Steve Goldberg	Training
8 Jan 97	Dr. Stan Halpin	Leadership
10 Feb 97	Dr. Robert Wisher	Training
13 Dec 96	Drs. Dexter Fletcher, John Metzko, John Morrison, Jesse Orlansky	Institute for Defense Analysis
3 Jan 97	Dr. Glenda Nogami	US Army War College, former ARI researcher
3 Jan 97	Dr. Curt Gilroy	Former ARI researcher